LUDLUM MODEL 4906 SERIES HAND AND FOOT MONITOR OPERATOR'S MANUAL

June 2021

Version 1.6.5

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LUDLUM MEASUREMENTS, INC.
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Section 1

Introduction

The Model 4906 Hand & Foot Monitor (HFM) is intended for checking low-level alpha and beta and or gamma contamination depending on the configuration. Six detectors are mounted to cover both sides of each hand and the bottom of each foot. For alpha-only systems, these detectors are air-proportional type, while for alpha and beta systems, gas-proportional detectors are used. A third option uses pancake cluster detectors to detect alpha, beta, and gamma radiation. An optional seventh detector may be added for frisking as well. The large color touch-screen display allows user-friendly instruction and clearly shows the status of each detector. Customizable audio files can provide the user with voice prompts or site-specific instructions. An Ethernet communications port allows remote monitoring and supervision.

Many similar systems use Gaussian statistics, which lead to substantial errors when count rates are very low. The Ludlum Model 4906, however, uses Poisson statistics when setting alarm points and determining false alarm rates for generally low count alpha channels. In addition, generally higher count beta channels use Gaussian statistics where they are most applicable.

Software routines are available to assist in calibration; such routines automatically generate detector data at different operating voltages. Other automated routines make routine source checks or false alarm tests easy to perform. Text files are also easy to generate, streamlining the documentation requirements. The computer, running Windows 7 ™ Pro, simplifies the attachment of USB memory sticks, printers, or alternate input devices.

An optional light stack is available, which mounts on the back side of the hand cabinet. Utilizing long-life LEDs (light-emitting diodes), the stack prominently displays green status (everything OK), yellow status (instrument/detector failure), and red status (radiation contamination alarm).

System setup is protected by two passwords. The Level 1 password provides limited access to the setup screens. The Level 2 password allows full access. The default passwords are:

- Default Level 1 Password – 1111
- Default Level 2 Password – 2222

Section 2

Features and Specifications

MODEL 4906A HFM:

DETECTORS: six alpha air proportional detectors for the feet and both sides of the hands

- ***HAND***: 13.0 x 23.2 cm (5.1 x 9.1 in.), 79% open screen (301 cm^2 {46.8 in^2}active, 238 in^2 {36.9 in^2} open)
- ***FOOT***: 15.6 x 33.3 cm (6.1 x 13.1 in.), 58% open screen (518 cm^2 {80.4 in^2} active, 301 cm^2 {46.6 in^2} open)

DETECTOR MDA: Minimum MDA range estimate assumes 95% detection probability, 0.1% false alarm probability, 10 second count time, background in the below stated range, and efficiency at the below stated levels.

- ***HAND***: 400-550 dpm
- ***FOOT***: 600-720 dpm

BACKGROUND COUNT RATE: Background count rates vary with many factors (discriminator levels, high voltage settings, environmental differences), but a properly calibrated Model 4906 HFM can be expected to have background readings in the following ranges.

- **HAND**: 1-10 cpm
- **FOOT**: 5-15 cpm

DETECTOR EFFICIENCY (4π)

- **HAND**: 12% (4π) ^{239}Pu
- **FOOT**: 10% (4π) ^{239}Pu

COUNT TIME: adjustable from 1 to 1000 seconds

OPERATING VOLTAGE: (Altitude Dependent)

- Determine the appropriate operating voltage for each detector using plateau data from the 4906 FOM utility.
- As a general rule, operating voltage will drop as elevation above sea level increases (roughly at a rate of 25 V per 305 m (1000 ft) with a starting point of 2050 V at sea level).

☢ **MODEL 4906AB HFM:**

DETECTORS: six alpha/beta gas proportional detectors for the feet and both sides of the hands

- ***HAND***: 13.0 x 23.2 cm (5.1 x 9.1 in.), 79% open screen (301 cm^2 {46.8 in^2} active, 238 cm^2 {36.9 in^2} open)
- ***FOOT***: 15.6 x 33.3 cm (6.1 x 13.1 in.), 58% open screen (518 cm^2 {80.4 in^2} active, 301 cm^2 {46.6 in^2} open)

DETECTOR MDA: Minimum MDA range estimate assumes 95% detection probability, 0.1% false alarm probability 10 second count time, background in the below stated range and efficiency at the below stated levels.

- ***HAND***:
  - Alpha = 280-425 dpm
  - Beta = 950-1300 dpm
- ***FOOT***:
  - Alpha = 1200-1450 dpm
  - Beta = 2600-3700 dpm

BACKGROUND COUNT RATE: Background count rates vary with many factors (discriminator levels, high voltage settings, environmental differences), but a properly calibrated Model 4906 HFM in a suitably low-background area can be expected to have background readings in the following ranges.

- **HAND**: Alpha = 1-10 cpm Beta = 250-500 cpm

- **FOOT**: Alpha = 5-30 cpm Beta = 500-2000 cpm

DETECTOR EFFICIENCY (4π)

- **HAND**: Sr^{90}/Y^{90} = 23% Th^{230} = 15%
- **FOOT**: Sr^{90}/Y^{90} = 11% Th^{230} = 5%

COUNT TIME: adjustable from 1 to 1000 seconds

OPERATING VOLTAGE: (Altitude Dependent)

- Determine the appropriate operating voltage for each detector using plateau data from the 4906 FOM utility.
- It may be necessary to select a high-voltage operating point that is not the optimal for the individual alpha or beta channel in order to balance performance between the two channels and maintain required efficiencies.
- As a general rule, operating voltage will drop as elevation above sea level increases (roughly at a rate of 25 V per 305 m (1000 ft) with a starting point of 2050 V at sea level).

☢ **MODEL 4906P HFM:**

DETECTORS: six clusters of GM pancake detectors – 6 pancake clusters for feet and four five-pancake clusters to cover both sides of hands.

- **HAND:** ^{14}C = 3% ; ^{99}Tc = 12%; ^{137}Cs = 12%; ^{237}Pu = 12%; $^{90}Sr/^{90}Y$ = 23%; ^{57}Co = 0.15%
- **FOOT:** ^{14}C = 3%; ^{99}Tc = 10%; ^{137}Cs = 10%; ^{237}Pu = 12%; $^{90}Sr/^{90}Y$ = 23%; ^{57}Co = 0.15%

COUNT TIME: adjustable from 1 to 99 seconds

OPERATING VOLTAGE: 900 V

☢ **COMMON FEATURES:**

DISPLAY: 30.7 cm (12.1 in. diagonal) TFT LCD SVGA

AUDIO: 8-ohm speaker

SYSTEM CONTROLLER: fan-less Single Board Computer (SBC) running Windows 7 ™ Pro

POWER SUPPLY INPUT: 100-240 Vac @ 47-63 Hz (requirement for wall outlet power)

POWER SUPPLY OUTPUT: 12 Vdc, 7 A max, 84 W (requirement for 4906 input power coming from power supply)

GAS SUPPLY REQUIREMENTS: 100 SCCM (150 with gas frisker) at 2 PSI minimum at system input. 15 PSI maximum at system input. 100 SCCM (150 with gas frisker) at 2 - 5 PSI recommended at system input. Recommended gas type is P10. Adjust primary (hand and foot) and frisker gas circuit flow rates to the following recommended flow rates:

- **Primary (Hand and Foot): 100 SCCM**
- **Frisker: 50 SCCM**

TEMPERATURE: 0 to 40 ºC (32 to 104 ºF)

HUMIDITY: 0-95% RH

CONSTRUCTION: welded aluminum with powder-coat finish, stainless steel

WEIGHT: 72.5 kg (160 lb)

DIMENSIONS: 121 x 79.8 x 90.2 cm (47.6 x 31.4 x 35.5 in.) (H x W x D) step-up only 3.8 cm (1.5 in.)

USER CONTROLS

- *ONE HAND* pushbutton allows for one-hand use.
- *ALARM/ACK* pushbutton allows for alarm acknowledgment and reset.

SOFTWARE FEATURES

- Large display and customizable audio feedback create a clear and easy-to-use user interface.
- Automatic routines for detector setup and alarm calculations.

- Three alarm modes allow user to maximize throughput, maximize sensitivity, or to fix the minimum detected activity (MDA) and count time.
- Display clearly shows status to user and indicates location of possible contamination.
- Ethernet interface built-in, email capability on alarm or failure (if connected to server)
- Logs each use, operational test, and calibration

OPTIONS

- LED light stack easily added to communicate status at a glance.
- Ethernet software indicates multiple units' status, logs use.
- Gas-proportional detector (as well as a GM pancake detector) is available for recorded frisking.

BACKGROUND TIME

- Mandatory user defined background accumulation on power-up, keeps rolling update during operation

Section 3

Software License Agreement

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Section 4

Safety Considerations

Caution

The operator or responsible body is cautioned that the protection provided by the equipment may be impaired if the equipment is used in a manner not specified by Ludlum Measurements, Inc.

Environmental Conditions

- Indoor Use
- No maximum altitude
- Temperature range of 0 to 40 °C
- Maximum relative humidity less than 95% (non-condensing)
- Main supply voltage range 100-240 Vac (powers +12 Vdc desktop power supply)
- Maximum transient voltage of 1500 Vac, Installation Category (Overvoltage Category) II (as defined by IEC 1010-1)
- Pollution Degree 2 (as defined by IEC 664)

Warning Markings and Symbols

As per requirements for CE marking, the Model 4906A is marked with the following warning symbols, in accordance with EN61010-1:

DIRECT CURRENT (DC) (IEC 417, No. 5031) – designates an input receptacle that accommodates a power cord intended for connection to DC voltages. Appears on connection panel.

CAUTION (per ISO 3864, No. B.3.1) – designates safety issues. The operator should read the manual in order to understand the proper use of this instrument.

The "CE" mark is used to identify this instrument as being acceptable for use within the European Union.

Section 5

Description of Controls and Functions

- **OPERATION –** In normal operation the user steps up on the base plate, positions feet to block the optical sensors, inserts hands into the hand cabinet far enough to block the beams, and counting will commence. The time remaining will show on the display. If the user leaves before time is up, an "Incomplete" condition will be displayed and sounded. Once time is up, either a green **CLEAR** message is displayed, or a red **ALARM** message is displayed. There is a short delay as the user exits the system, after which the display will return to **READY**. Optionally, the user can them remove the 4906 Frisker from its holder (if equipped) to begin frisking. The screen will change to display the count rate for all appropriate channels when the frisker is lifted from the holder while the 4906 is in the **READY** state. The user then frisks as needed and returns the frisker to the holder. While frisking, the screen and installed light stack (optional) will indicate when the frisker is currently counting at a rate above the set alarm rate for any channel. If the minimum required frisk time is not met, an "Incomplete" condition will be displayed and sounded. Once the frisking is complete and the frisker returned to the holder, the 4906 returns to the READY state if the frisker alarm count rate was never surpassed.

- **DISPLAY (**on top center of instrument) – 30.7 cm (12.1 in.) diagonal color touch screen SVGA LCD

- **ONE HAND button** (on top front of instrument) – requests the starting of a measurement with only a single hand sensor blockage. When pressed, the button is backlit with a blue color LED (light-emitting diode). This mode will be active for 30 seconds, after which the button-light will be extinguished.

- **ALARM ACK button** (on top front of instrument) – allows the radiation alarm to be silenced and/or reset, depending on setup configuration. Press once to silence the audio, and press a second time to reset the alarm. It is backlit with a red color LED while an alarm is active.

- **POWER/RESET** (on lower side of column) – button to turn instrument **ON** and **OFF**. Momentarily pressing the button toggles the power, so if

the 4906 is off, a momentary press turns it on, while a momentary press with the 4906 in the ON state initiates the shut-down sequence.

Section 6

Getting Started

Unpacking and Repacking

Caution

The Model 4906 weighs approximately 72.5 kg (160 lb). Take necessary precautions when lifting the instrument to prevent personal injury or strain. The instrument may be tipped backwards and rolled on the two offset wheels. If this is done, use caution when negotiating ramps to avoid being pinned or crushed by the instrument.

Remove the calibration papers and place in a secure location. Remove the instrument and accessories (power supply, cable, etc.) and ensure that all of the items listed on the packing list are in the carton. Check individual item serial numbers and ensure calibration certificates match. The Model 4906 serial number is located on the lower side panel.

To return an instrument for repair or calibration, provide sufficient packing material to prevent damage during shipment. Also provide appropriate warning labels to ensure careful handling. Include detector(s) and related cable(s) for calibration.

Every instrument must be accompanied by an Instrument Return Form, which can be downloaded from the Ludlum website at www.ludlums.com. Find the form by clicking the "Support" tab and selecting "Repair and Calibration" from the drop-down menu. Then choose the appropriate Repair and Calibration division where you will find a link to the form.

Software Installation

Interface software supplied with the instrument is already installed. A copy of the Windows 7 ™ Pro product key is supplied. User must comply with the Ludlum software license agreement found in Section 3 of this manual. Updates to the software are provided from the LMI website at www.ludlums.com under Support\Software Downloads or from the Service & Support section of the Model 4906A and Model 4906AB pages respectively.

Power on Sequence

When the Model 4906 is first powered up, the yellow light stack light is illuminated, and units equipped with a frisker, sound frisker audio "clicks." The 4906 monitor then turns on and displays the internal SBC boot sequence. Following a successful boot sequence, the Windows 7 Pro start-up sequence is performed. Once Windows has started, the Model 4906 HFM Supervisor software automatically starts and displays the Initializing notification as communication between the Supervisor software and Model 4906 hardware is established. The system then establishes the background level with a background count and continues to update the background radiation levels every second.

Powering the Model 4906 On

1. Connect the AC adapter to a 120 volt electrical outlet.

2. Turn the Model 4906 on by momentarily pressing the POWER/RESET button located on the lower left side.

3. The Model 4906 will take approximately two minutes to boot.

4. After the initial background update is completed, the Model 4906 will be ready for operation.

Powering the Model 4906 Off (From Software)

1. Select the Exit button on the main screen.

2. Enter either the Level 1 or 2 password.

3. Tap the **Shutdown** button. After confirming the selection, the on-board computer and other 4906 hardware will shut down.

Powering the Model 4906 Off (POWER/RESET Button)

1. While the Model 4906 HFM is on, press and release the POWER/RESET button located on the lower column.

2. The on-board computer and other 4906 hardware will shut down.

Normal Operation

1. Step on base plate with shoes blocking the optical sensors. Both feet indicators on the display will be hidden once their beams are broken.

2. Insert hand(s) into the hand cabinet far enough to block the optical sensors. Both hand indicators on the display should then also be hidden. No flashing position indicators should be visible at this time.

a. Alternative: Press the One Hand button then insert a hand into either of the hand cabinets far enough to block the optical sensors.

3. Counting will begin with the time remaining displayed on screen.

4. If user leaves before count time expires, an "Incomplete" condition will be displayed and sounded. As soon as the hands and feet are repositioned, the count will begin again.

5. Once the count time has expired, either a green CLEAR message is displayed or a red ALARM message is displayed.

6. There is a short delay when the user exits the Hand and Foot Monitor, after which the display will return to READY.

Status Colors

The Model 4906 uses color to identify the status of the instrument at any given time. The status box and detector indicators change color depending on the various states of the Hand and Foot Monitor. The colors are:

- Green – ready for operation
- Yellow – failure or not READY
- Red – radiation alarm
- White – counting
- Blue – initializing or updating background

The lights and audio on the light stack operate as follows:

- Red – Model 4906 has a radiation alarm. In addition to the voice audible alert, there will be a fast, beeping audible alarm if the optional light stack is mounted.
- Yellow – Model 4906 is in a fail condition or is not ready to scan. If a fail condition is present, there will be a slow, beeping audible alarm if the optional light stack is mounted. While in any setup screens, forcing a background update, or when the Supervisor application is not running, the yellow light will be ON.
- Green – Model 4906 is ready to count.

Instrument Failure

There are several conditions that cause system failure:

1. HARDWARE COMMUNICATION – A Model 4906 system failure is triggered any time the Supervisor software is unable to successfully communicate with the 4906 host board. If this failure occurs, it may be due to an improperly set COM port option or an improperly installed USB communication cable between the SBC and host board.

2. GAS FLOW – For 4906 systems equipped with gas detectors and gas flow controllers, an error in the gas flow system triggers a system failure. Gas flow system errors occur when flow sensors and solenoid outputs do not fall within expected parameters as defined by the user. Additionally, gas flow errors occur if communication to the flow sensors cannot be maintained.

3. LOW BACKGROUND – The instrument continually checks the detectors for abnormally low readings as defined by the low-background alarm set points. When this condition is detected, the detector map on the main screen will indicate which detector failed. This condition normally signals a failure of either the detector or its associated preamp electronics.

4. ALPHA KEEP ALIVE COUNT – Due to the rare nature of alpha count events, it is possible that an alpha channel background average with background count times in the one to three minute range will eventually go through a time period where they naturally reach a zero background average. For this reason, alpha channel low-background values are generally set to zero to avoid low-background alarms during normal operation. Instead, a built-in alpha keep alive timer is reset every time an alpha channel count is received. This timer is set internally to five minutes. Thus, if any five-minute period passes with no alpha counts received on a specific detector, that detector's low-background alarm will be triggered even if the alpha low-background level is set to zero.

5. HIGH BACKGROUND – The instrument continually checks the detectors for abnormally high readings as defined by the high-background alarm set points. When this condition is detected, the detector map on the main screen will indicate which detector failed. This condition normally signals a failure of either the detector or its associated preamp electronics, but can also warn of some nearby strong source of radiation. At any rate, the possibility of such a nearby strong source of radiation warrants further investigation.

6. MODE BASED – For each operation mode, if parameters and settings entered by the user are beyond the capability of the system based on current background levels and collected efficiency data, a mode specific system failure is triggered. For example, if the user has selected the Minimum Count Time mode (Mode 3) and set the maximum allowed count time to 15

seconds, but the selected Hand MDA is too close to background and requires a 20-second count to meet the specified probability settings, a Mode 3 – Calculated count time exceeded maximum count time error occurs. More information on mode specific system failures is given in the description of each mode.

Background failures can be set to non-latching from the options tag in the operational setup screen. This will allow the background to recover automatically and not require user intervention.

Section 7

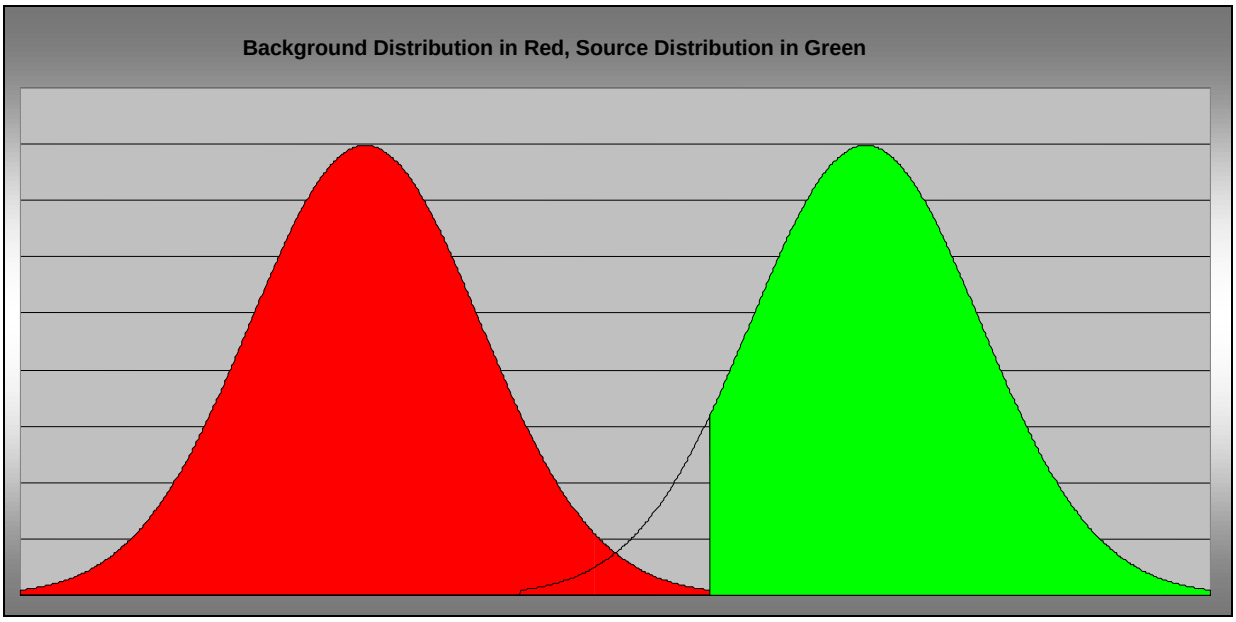
Statistics Background

Note

Before using the instrument, be sure to check, and change if necessary, all the operating parameters. You may wish to consult your Radiation Safety Officer (RSO) or radiation instrument supervisor for guidelines. The Model 4906 does have default parameters, but these parameters may not be correct for your application.

A basic understanding of statistics is required in order to appropriately set up the Model 4906. It should be clearly understood that radiation is a random event, and so counting radiation results in a distribution of counts. If you record a set of readings from a radiation detector, you will get a distribution of counts centered around some average number of counts. In other words, successive readings are most likely to be near the average reading, and less likely to be far from the average reading.

It should also be clear that there is almost always some amount of "noise" in any counting system, resulting from non-zero data even when no radiation sample is present. In other words, the situation is not "black and white" but rather shades of gray. In the specific example of alpha radiation, "noise" or background generally is caused by radon, a colorless, radioactive, inert gaseous element formed by the radioactive decay of radium. The counting of background radiation then also results in a distribution of counts. The graph on the following page illustrates a background distribution (in red) on the left, and then (in green) on the right, a distribution of counts due to a source of radiation. The vertical line represents a possible alarm point, chosen such that background radiation rarely exceeds the alarm point, and yet the source radiation almost always is above the alarm point.



This graph illustrates that if background radiation is very low and the source is very high, it would be easy to select an alarm point such that the background would always be less than the alarm point, and the source would always be above the alarm point. Usually, however, the distribution probabilities overlap somewhat, leading to somewhat of a question whether background radiation caused the alarm, or whether it is due to a source of radiation. Many times the user is interested in knowing the Minimum Detectable Activity (MDA), which is normally defined as the amount of radiation whose alarm point has a 95% chance of being triggered by the radiation, with only a 0.1% chance of being triggered by background radiation. In this situation we have to talk about False Alarm Rate and Confidence Levels:

False Alarm Rate (FAR) – the percentage chance that an alarm is caused by background radiation

Confidence Level – the percentage chance that an alarm is caused by a radiation source

In a course of statistics, the student will study many different distributions, the details of which are beyond the scope of this manual. The distribution that best describes alpha counting is called a Poisson distribution, which is characterized by a low average number of counts. The Poisson distribution is given by the formula (where α is the average count or expected count and k is the number of occurrences), the probability of which is given by the function:

$$f(k;\alpha) = \frac{\propto^k e^{-\propto}}{k!}$$

As a practical example, if a particular alpha detector were to have a background of 1 cpm on average (α=1.0), then the actual distribution of successive one-minute counts would have the following probabilities:

k	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Poisson probability	36.788%	36.788%	18.394%	6.131%	1.533%	0.307%	0.051%	0.007%

Or in other words, each one-minute count would have a 36.788% of being 0, and a 36.788% of being 1, but only a 0.051% chance of being a 5. You can add the successive probabilities to determine the probability of being less than or equal to a particular number i.e. There is a 73.6% of the next count being 1 or less. And you can subtract the sums of the probabilities from 1 to calculate how many one-minute counts are above 1 i.e. (1 - 73.6%) = 26.4%.

You can use this chart to calculate the false alarm rate (if the average background is 1) if the alarm point is set at 5:

FAR = 1 - (36.788% + 36.788% + 18.394% + 6.131% + 1.533%) = 0.366% or 3.66 per 1000

The same procedure can be done for confidence level if you want to find the probabilities of a particular count being equal or above an alarm point, if the average count from a particular source is known.

As a practical example, assume that a 1000 dpm alpha source is put on a 10% efficient detector. If we count for 6 seconds ($1/10^{th}$ of a minute), the average expected count is $1000 \times 10\% \times 1/10^{th}$ minute = 10 counts in 6 seconds. If we redo the chart of probabilities for a Poisson distribution around 10, we have:

k	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Poisson	0.005%	0.045%	0.227%	0.757%	1.892%	3.783%	6.306%	9.008%	11.260%	12.511%	12.511%

And with this chart, you could then calculate the confidence level of a particular alarm point, or pick an alarm point to achieve a particular confidence level. For example, an alarm point of 5 has a confidence level (CL) of:

CL = 1 - (.005% + .045% + .227% + .757% + 1.892%)

While alpha counting is best described by the Poisson distribution (due to the rare nature of alpha events), beta counting is more appropriately described by a Normal or Gaussian distribution. When using such a distribution confidence level, a false alarm probability can also be appropriately expressed in terms or sigma (standard deviation). While expressing an alarm point in terms of sigma

versus confidence level, and false alarm probabilities do not result in different results (for any given number of sigma above/below the alarm point or background mean there is a corresponding sigma multiple), the symmetrical nature of the Normal distribution, as well as familiarity with statistical math (or lack thereof), may lead to various preferences, so both options are provided.

The Normal distribution is used in fundamentally the same manner as the Poisson distribution described above. The normal distribution is described by the following equation:

$$f(\beta) = \frac{1}{\sqrt{(2\pi\sigma^2)}} e^{\frac{-(\beta-\mu)^2}{2\sigma^2}}$$

β = beta count

σ = standard deviation

μ = mean

Section 8

Supervisor

The Model 4906 Hand and Foot Monitor is controlled by the Supervisor application. The Supervisor starts automatically when the Model 4906 is booted. If the Supervisor is not running, it can be started from the **Model 4906 Hand and Foot Monitor** icon on the desktop. When the Supervisor is not running, the yellow light on the light stack will be lit to indicate that the Model 4906 is not in service.

Touch Screen Operation

For normal operation, the Supervisor requires little to no interaction. When interaction is required, the Supervisor can be controlled using the LCD touch screen or through an external USB keyboard and mouse. Tap on the screen to "click" on buttons. Each screen in the Supervisor has a button at the top right that will open an on-screen keyboard. Numeric fields have up and down arrows that provide a means to quickly increment or decrement the value as well as a pop-up keypad for typing large numbers in quickly.

Operate Screen

The Operate screen is where the normal operation of the Model 4906 takes place and contains the following:

Title Bar – Displays the user-definable site, location, customer ID, and LMI serial number of the Model 4906.

Status Display – Displays the current status of the Model 4906. The status can be one of the following:

- Ready
- Clean
- Counting
- Incomplete
- Alarm

- Failure
- Updating Background
- Initializing

Status Text – displays information about the current status.

Clock/Timer – displays the current time when not counting and a countdown timer when the Model 4906 is counting or initializing a new background.

Detector Status Display – graphical representation of the detectors with color coded background to indicate their status. This includes gas flow status indication for units equipped with gas detectors.

Exit Button – allows the user to exit the Supervisor application, restart, or shut down the Model 4906. It is password protected. Click the Exit button to access the shutdown screen.

Setup Button – allows access to the various setup screens. It is password protected.

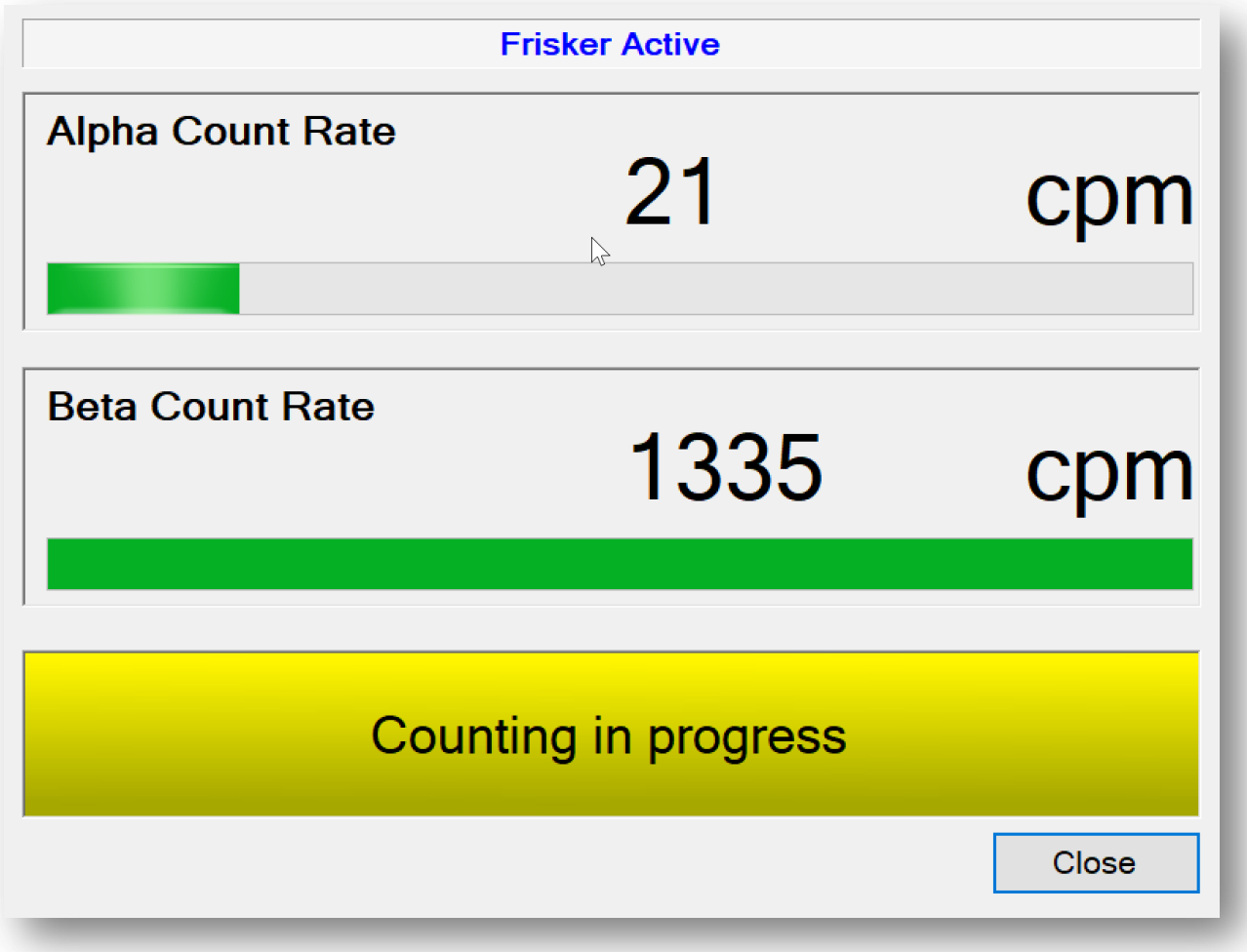
Version – The software version is displayed next to the LMI logo in the bottom, left corner of the screen.

Gas Status Indicator (if equipped) – The gas status indicator bar displayed at the bottom of the screen indicate the current flow state of the gas to that detector, as well as the error state. If the bar is green, no detected flow errors are present, while red indicates either low flow or a leak is present.

Frisker Status Indicator (if equipped) – The Frisker Status Indicator is located just below the Clock/Timer on Model 4906 units equipped with a frisker. It is a small rectangular graphic that shows a representation of either a GM or gas frisker probe indicating the frisker type. If the type is gas proportional, the indicator turns red when a gas flow error occurs.

Frisker Active Screen

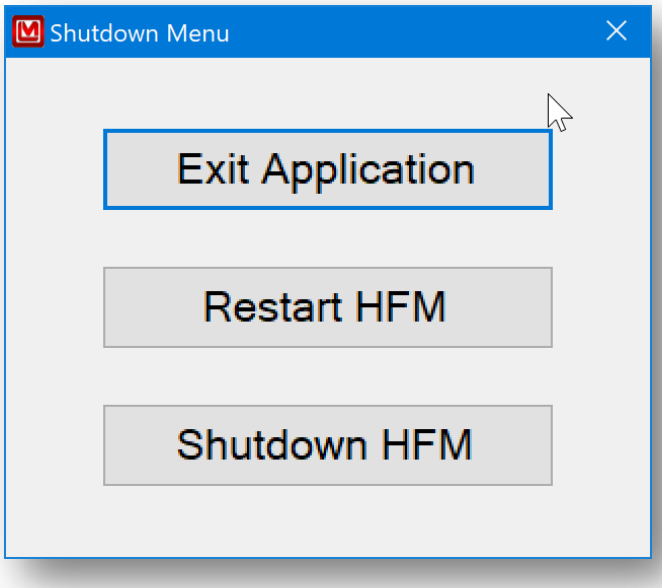
The Frisker Active screen appears any time the frisker (optional) is removed from the frisker hook with the Model 4906 HFM in the Ready state and the Operate screen visible (not in the Setup Menu).



The Frisker Active screen displays a status bar at the bottom of the screen with digitial and bar type count rate indicators for all channels at the top of the screen. If at any time during the frisking operation the count rate exceeds the set limit, the background of that section turns red, along with illuminating the red stack light if equipped. The Close button in the lower right corner can be used to close the Frisker Active screen, but Level 1 or 2 password access is required.

Shutdown Menu

The Shutdown menu provides access to restart or shut down the Model 4906 or to exit the Supervisor application and is accessed through the Exit button on the Operate screen. The Level 1 or 2 password is required before accessing this screen. It is recommended that users shut down the Model 4906 through software. Use of the POWER/RESET button to shut down the 4906 is also acceptable (though software shutdown is preferred), but direct removal of power without proper shutdown can lead to data corruption.



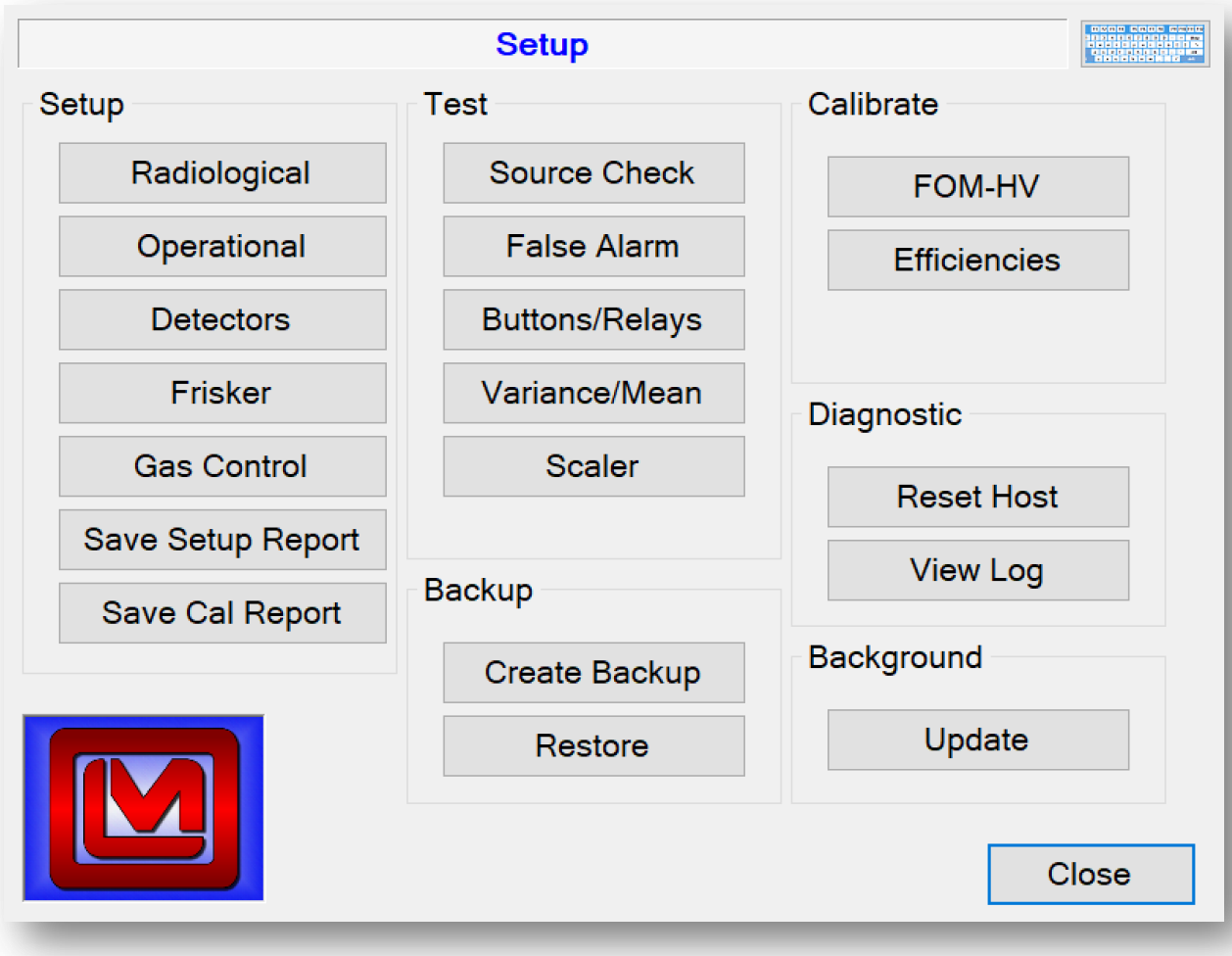
Exit Supervisor – closes the Supervisor application and provides access to the Windows 7 Pro environment. This is necessary for performing software updates, configuring windows settings such as printing or networking, or to provide access to the data files. A confirmation window will be displayed before the Supervisor application is closed.

Restart HFM – This function performs a restart of the Model 4906 operating system. A confirmation window will be displayed before the system is restarted.

Shutdown HFM – This function shuts down the operating system in preparation for powering off the Model 4906. This option should always be used before powering off to prevent data corruption.

Setup Screen

The Setup button on the Operate screen provides access to the various setup and calibration functions of the Model 4906. The Level 1 or 2 password is required to access the Setup screen. The Level 1 password does not provide full access to all setup functions. Radiological, Operational, Detectors, Frisker (if equipped), Gas Control (if equipped), False Alarm, Variance/Mean, FOM and, Efficiency screens are not available using the Level 1 password.



Radiological – sets up the counting mode and its parameters, background alarms, and units of measurement.

Operational – sets up passwords, user-definable information, and options that control how the Supervisor application operates and displays information.

Detectors – sets up the detector high voltage (HV), lower level discriminator (LLD), upper level discriminator (ULD), and lower level discriminator 2 (LLD2), if equipped. A calibration wizard is available to calibrate the various voltages and calibration constants.

Frisker – sets up frisker options such as frisker type, alarm points, frisker audio volume, discriminator levels, and high-voltage set point.

Gas Control – sets up gas flow controller values such as flow ON time, purge time, off time, error trigger counts and thresholds. Additionally, it displays detailed gas controller and flow status and initiates an immediate purge or gas controller reset if desired.

Save Setup – saves a report that contains the current hardware and software configuration.

Save Cal Report – save a calibration report.

Update – starts a new background initialization.

Source Check – performs a source check to verify all detectors are operating correctly.

False Alarm – performs a false alarm test with a specified number of counting cycles for each detector.

Buttons/Relays – tests the input and output, including buttons, infrared sensors, lights, and relays.

Variance/Mean – calculates the variance and mean for each detector.

Scaler – runs a simple timed scaler count.

FOM – finds the optimum HV set point for each detector by running a high-voltage plateau and calculating the Figure of Merit.

Efficiencies – sets up the source and isotope library to identify specific isotopes of interest and common sources used with the 4906. It determines efficiency data for various channels and sources through the efficiency determination utility or directly inputs desired efficiency numbers.

Reset Host – resets the internal host board. The host board is responsible for collecting the count data and passing it to the SBC though a USB serial port.

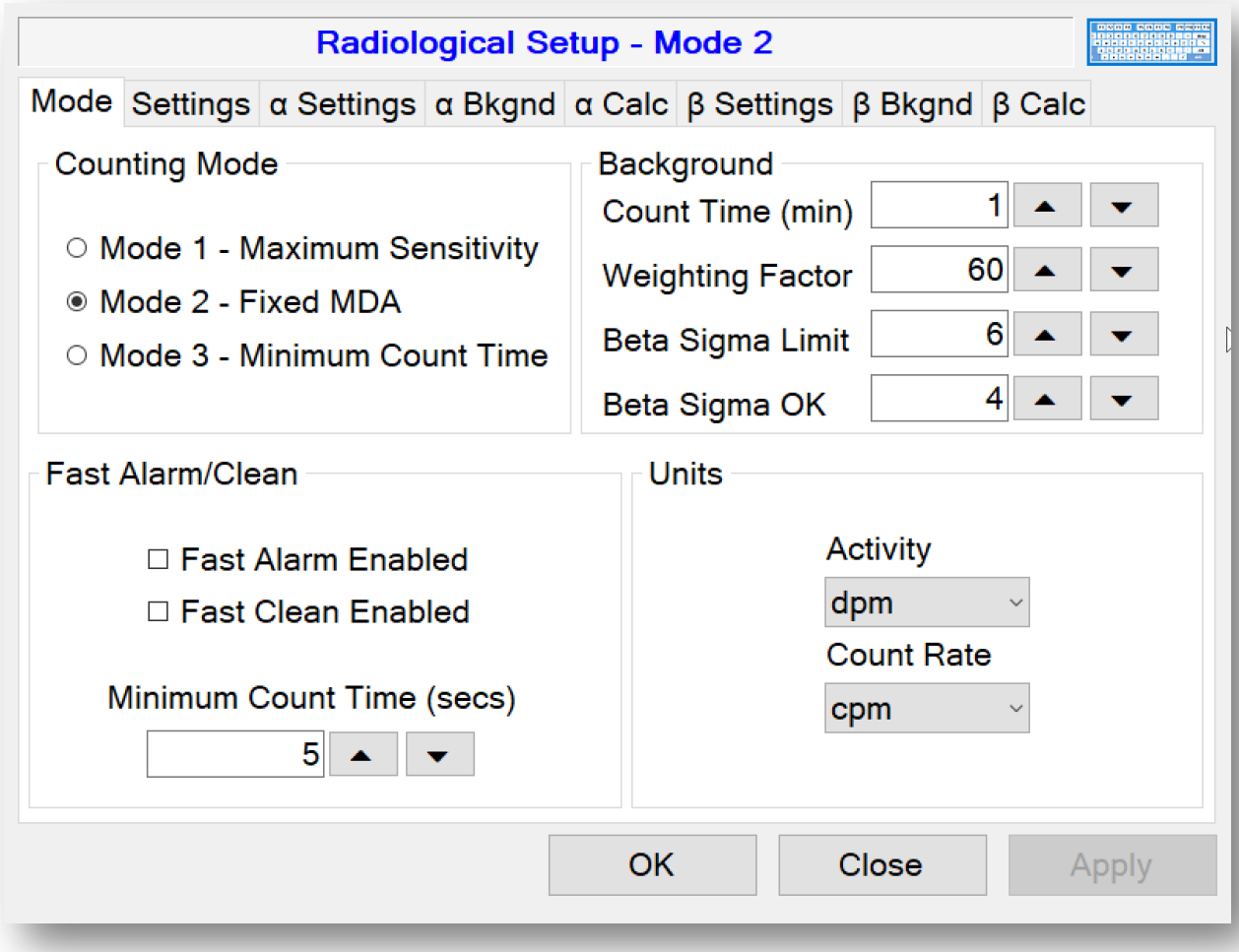
View Log – views the log and report files. System, background, and scan logs are created automatically. Other screens provide the ability to save a report that can be viewed here.

Create Backup/Restore – Create a backup of the system configuration to a user specified location such as a flash drive. This can be used to restore the configuration if necessary.

Section 9

Radiological Setup

The Radiological Setup screen provides access to the various parameters and options that control the counting modes, background alarm set points, and units of measure. The title indicates the current counting mode. The settings may be slightly different based on the system type but the functions are the same.



After making a change, press the Apply button to save the changes immediately. Press the OK button to save the changes and exit the Radiological Setup screen. Press the Close button to exit the screen without saving any changes.

Counting Modes

There are three counting modes available.

Mode 1 – Maximum Sensitivity

The maximum sensitivity mode calculates an alarm set point as low as possible considering the current background, count time, detection probability and false alarm probability. While the statistical distribution used differs between alpha (Poisson) and beta (Gaussian or Normal), the same basic concept applies. If any of these parameters change, the set point will be adjusted automatically. This allows the Model 4906 HFM to operate at the highest sensitivity level for a given set of background conditions and settings.

Additionally, a maximum MDA value is designated for the hands and feet when operating in Mode 1. If conditions and settings force the calculated minimum detectable activity (MDA) above the user defined maximum MDA, a system failure will occur to indicate the need for parameter adjustment or further investigation of the surrounding conditions and equipment.

Mode 2 – Fixed MDA

The alarm set point is calculated on the basis of the maximum allowable as determined by the MDA and its associated detection probability. The alpha channel again uses Poisson statistics while the beta channel uses Gaussian statistics to preform set point calculations.

If at any time the combination of settings and conditions causes the calculated set point to become near enough to the background average that the selected false alarm probability cannot be maintained, a system failure will occur to indicate the need for parameter adjustment or further investigation of the surrounding conditions and equipment.

Mode 3 – Minimum Count Time

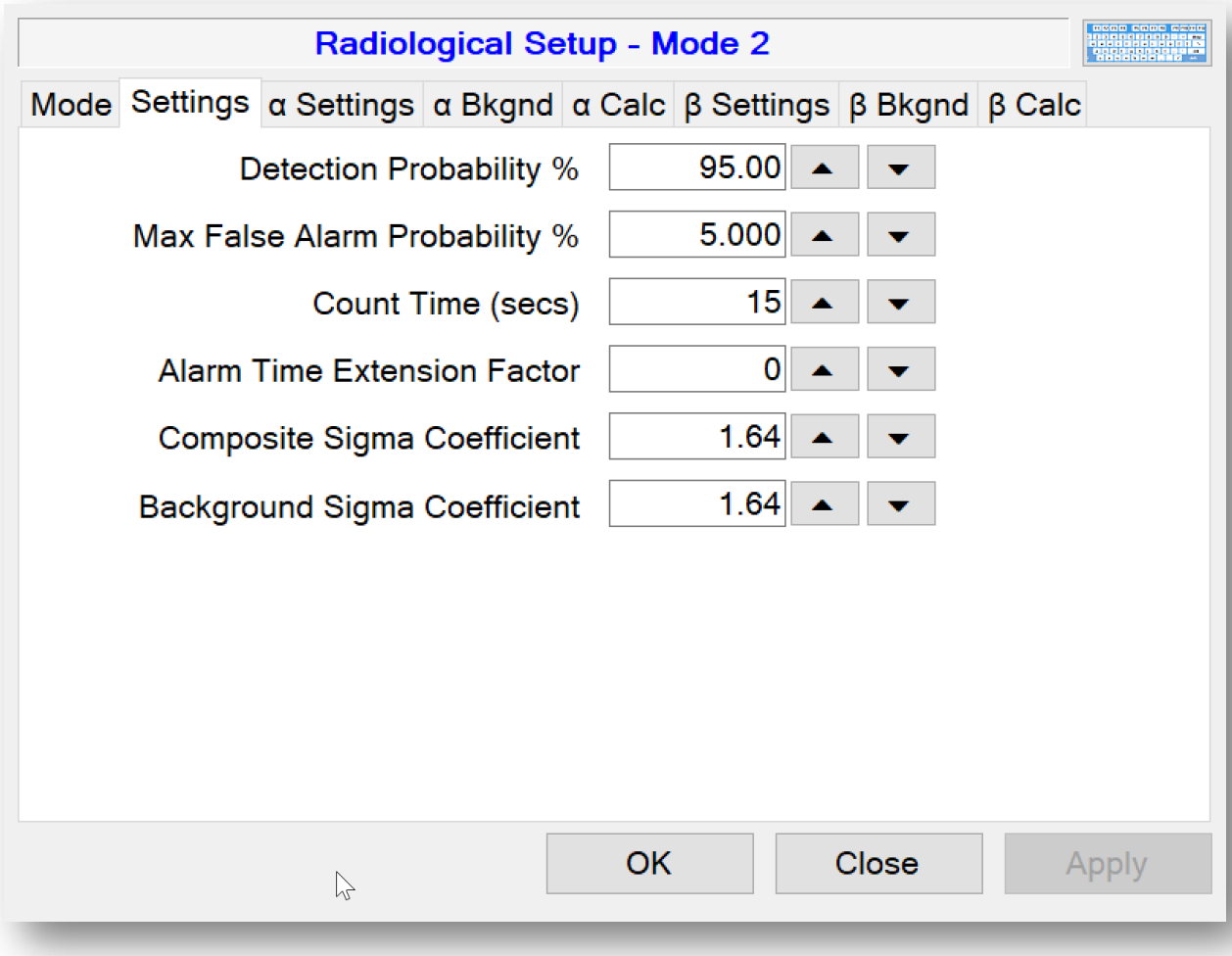
The minimum count time mode is intended to achieve maximum user throughput for a fixed MDA requirement. Mode 3 calculates the set point based on the background average, MDA, detection probability, and false alarm probability, such that the minimum acceptable count time is used.

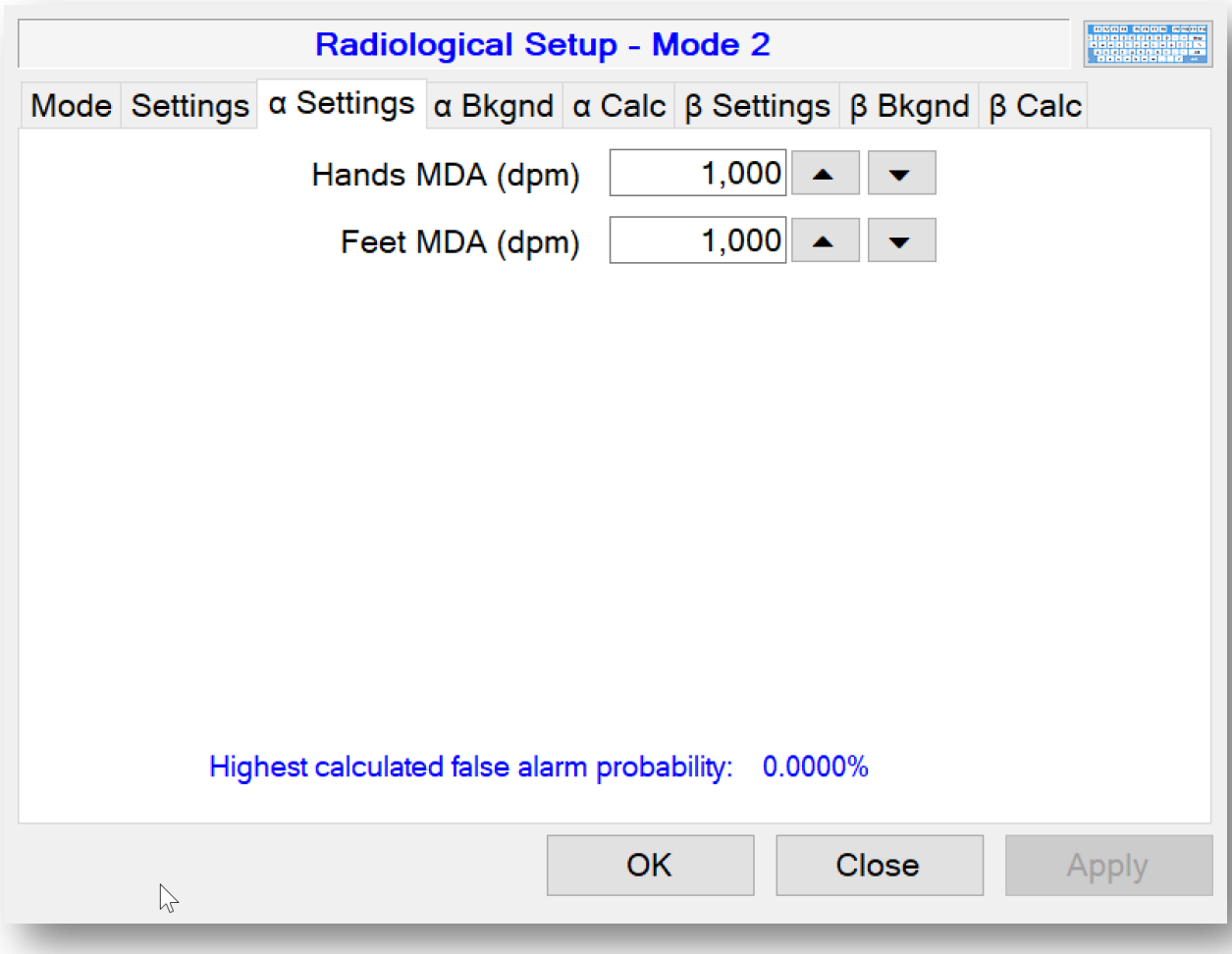
In the minimum count time mode, the user sets a maximum count time value. If at any time the calculated minimum count time needed to meet user selected probability thresholds exceeds the maximum count time value, a system failure will occur to indicate the need for parameter adjustment or further investigation of the surrounding conditions and equipment.

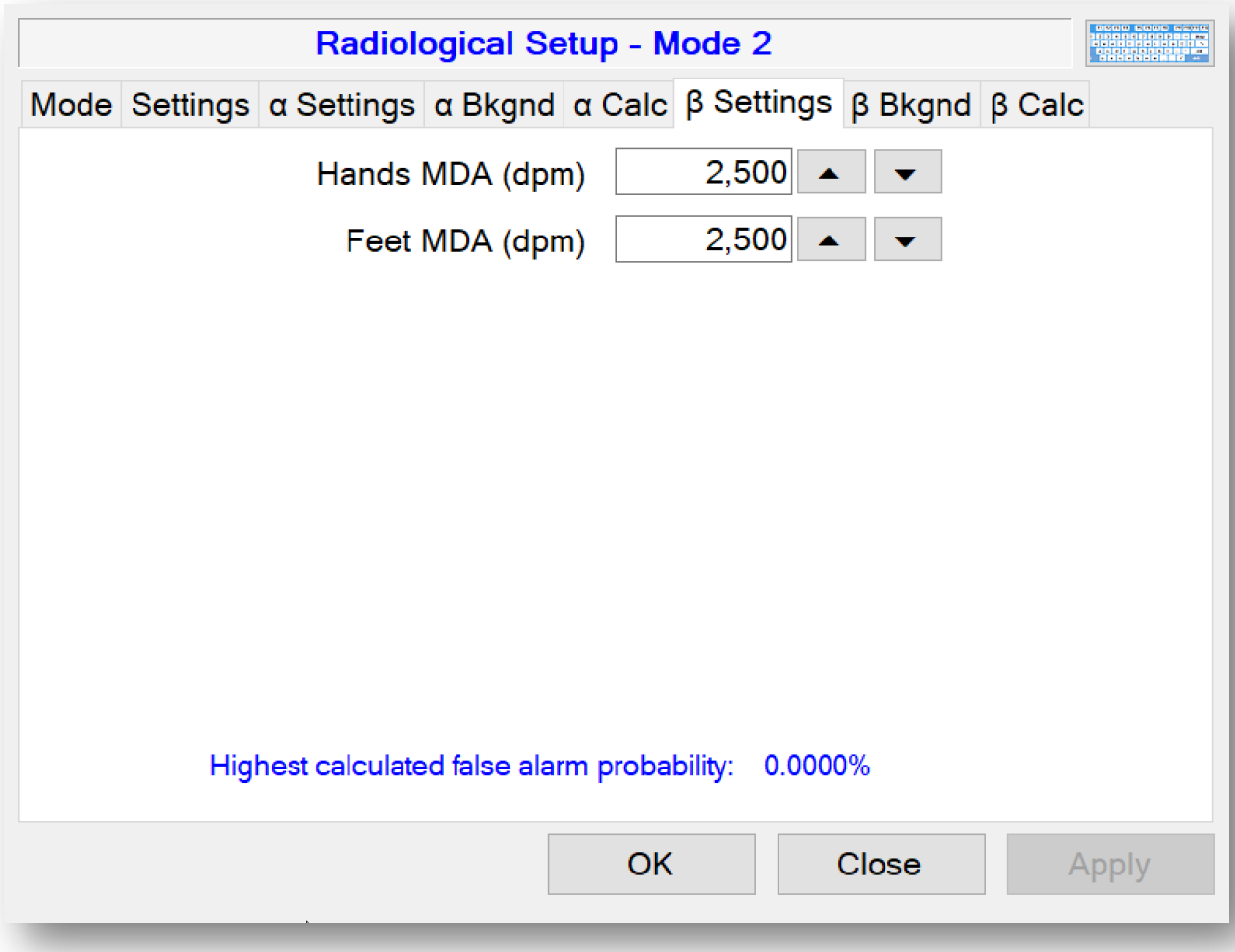
Count Mode Settings

The Settings tab(s) allows the various parameters that affect the operation of the count modes to be modified. After changing a setting, press the Apply button to save the changes immediately.

NOTE: Only the settings that apply to the current count mode are shown.




Radiological Setup - Mode 2
Mode
Settings
α Settings
α Bkgnd
α Calc
β Settings
β Bkgnd
β Calc
Hands MDA (dpm)
1,000
Feet MDA (dpm)
1,000
Highest calculated false alarm probability: 0.0000%
OK
Close
Apply



Hands Max MDA – sets the maximum allowed calculated MDA for the hands detectors in Mode 1 (maximum sensitivity).

Feet Max MDA – sets the maximum allowed calculated MDA for the feet detectors in Mode 1 (maximum sensitivity).

Hands MDA – sets the minimum detectable activity used in Mode 2 (fixed MDA) and Mode 3 (minimum count time) for the hand detectors.

Feet MDA – sets the minimum detectable activity used in Mode 2 (fixed MDA) and Mode 3 (minimum count time) for the feet detectors.

Detection Probability % - sets the minimum detection probability that must be met in order to avoid a system failure alarm in all modes.

(Max) False Alarm Probability % - sets the maximum false alarm probability that must be met in order to avoid a system failure alarm in all modes.

Composite Sigma Coefficient (Beta Only) – Directly tied to the Detection Probability %, this is another way of expressing how far below the MDA a set point must be set. Modifications to this value adjust the Detection Probability % automatically and vice versa. This setting is available in all modes.

Background Sigma Coefficient (Beta Only) – Directly tied to the False Alarm Probability %, this is another way of expressing how far above the background average a set point must be set. Modifications to this value adjust the False Alarm Probability % automatically and vice versa. This setting is available in modes 2 and 3.

Count Time – specifies the count time in seconds for Modes 1 and 2.

Maximum Count Time – specifies the maximum allowed count time in Mode 3 (minimum count time). If the calculated minimum required count time is greater than this value, a system failure occurs.

Minimum Count Time – specifies the minimum allowed count time in Mode 3 (minimum count time). If the calculated minimum required count time is less than this value, the count time will be set to this value.

Alarm Time Extension Factor - sets a multiplier of elapsed time that is used whenever an alarm condition is detected. The alarm time extension factor is adjustable from 0 to 1000. The default value is 0.

Units of Measure

The activity units of measure are used where a value is displayed as an activity. When changing the activity unit, the activity is automatically converted into the new unit of measure. The following units of measure are supported:

- dpm
- pCi
- nCi
- µci
- mCi
- Ci
- Bq

- kBq
- MBq

The count rate units are used where a value is displayed as a count rate. The following units of measure are supported:

- cps
- cpm

Updating Background

A new background is taken after the Supervisor application is started. The background count time is set here and is valid from 1 (default) to 10 minutes. A background update is forced when returning to the Operate screen from the Setup menu or when the Update button is pressed. During this time, the Model 4906 is considered not ready for use. Once a new background update is complete, the background is updated once every second.

Background Update Method

The background is updated in two stages. The first stage is a background count that is initiated whenever a new background is required. The count time for this is set in the Radiological screen. Once the count is complete, the accumulated counts are divided by the number of seconds to get an average count rate in units of cps. The second stage is the ongoing background update. During this stage, a new background average is computed with each one-second update, using a user-defined weighting factor.

The stage two background average is calculated using the equation:

$$R_{B(NEW)} = \frac{W \times R_{B(OLD)} + Bkg_{NEW}}{W + 1}$$

Where:

$R_{B(NEW)}$ = New background average (cps)

W = Dynamic weighting factor

$R_{B(OLD)}$ = Old background average (cps)

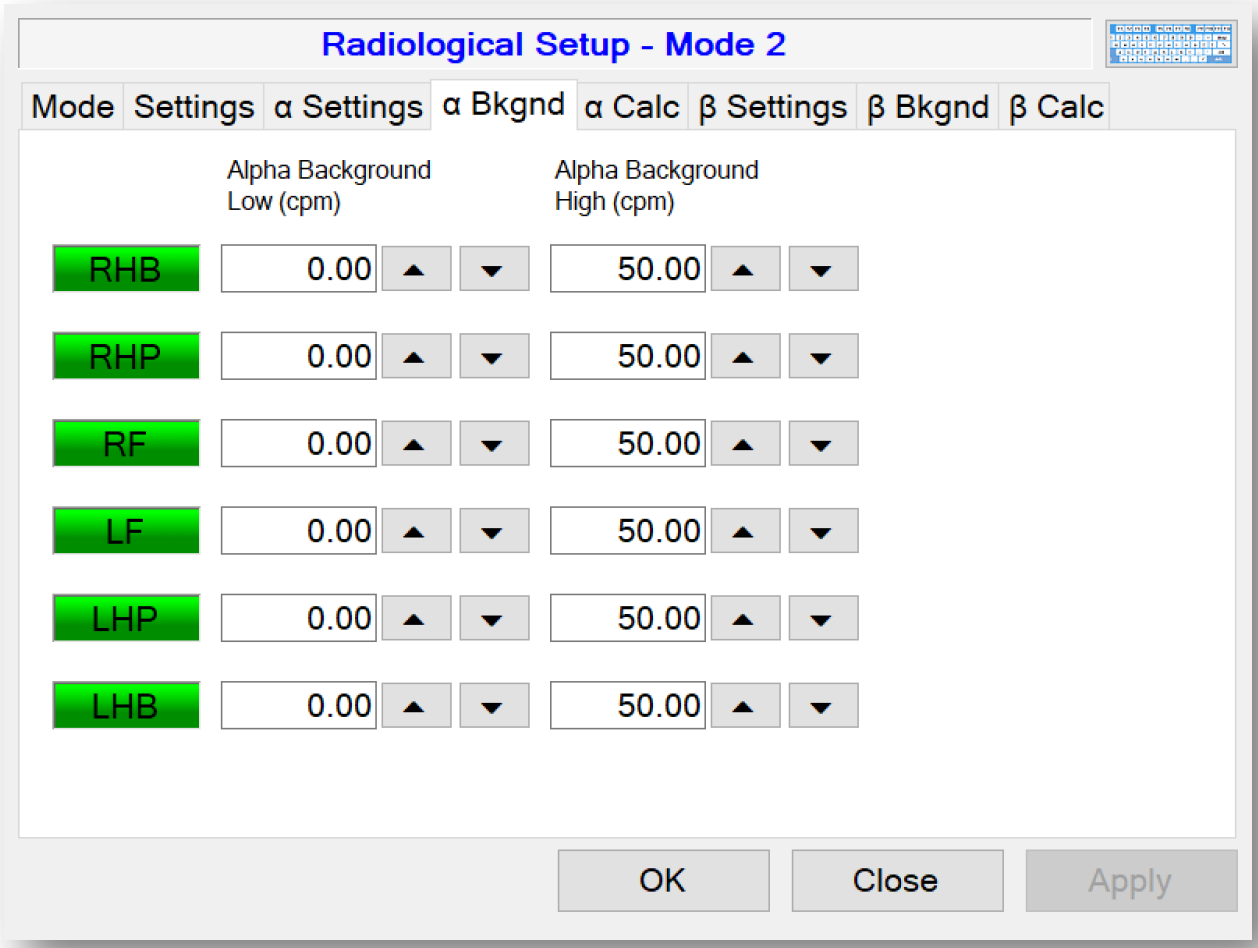
Bkg_{NEW} = New one-second background count

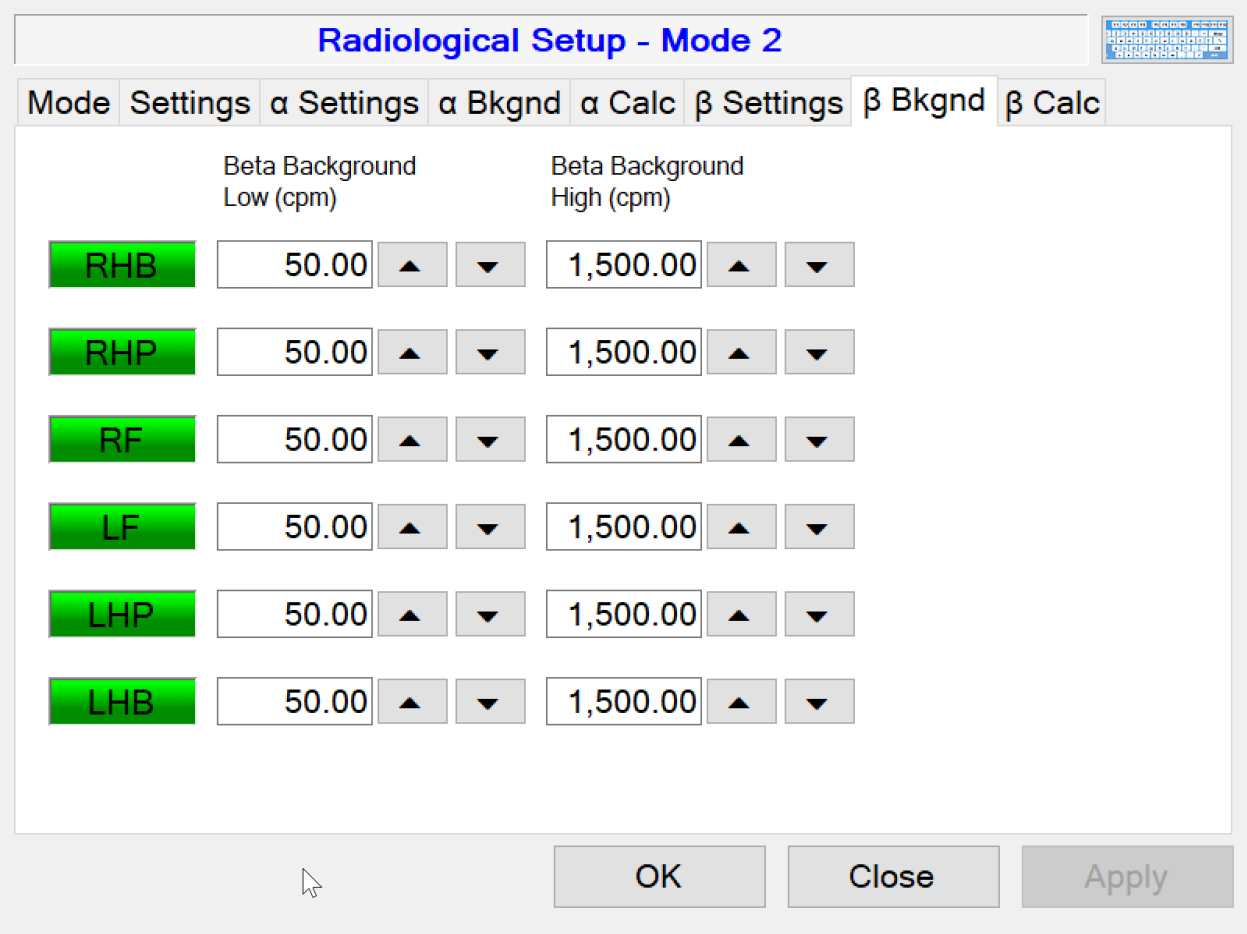
Before updating background, the counts are checked for spikes. A spike occurs when six seconds of counts are greater than five sigma of the average. A high background alarm is posted if three spikes occur consecutively.

In addition, on units equipped with beta detection equipment, the Sigma Limit and Sigma OK values determine how large of a beta background shift requires an immediate background update. If a sudden large background change is registered on the beta channel that is greater than the Sigma Limit value multiplied by the current background sigma value above or below the current background average, a tentative background reading is taken. At the end of this tentative update, if the background average has returned to within the Sigma OK value of the original background average, normal background averaging resumes and the large reading is considered a brief spike. However, if the background average does return to within the limit defined by Sigma OK, a fundamental background shift is assumed to have occurred and a new background update is initiated.

Background Alarms

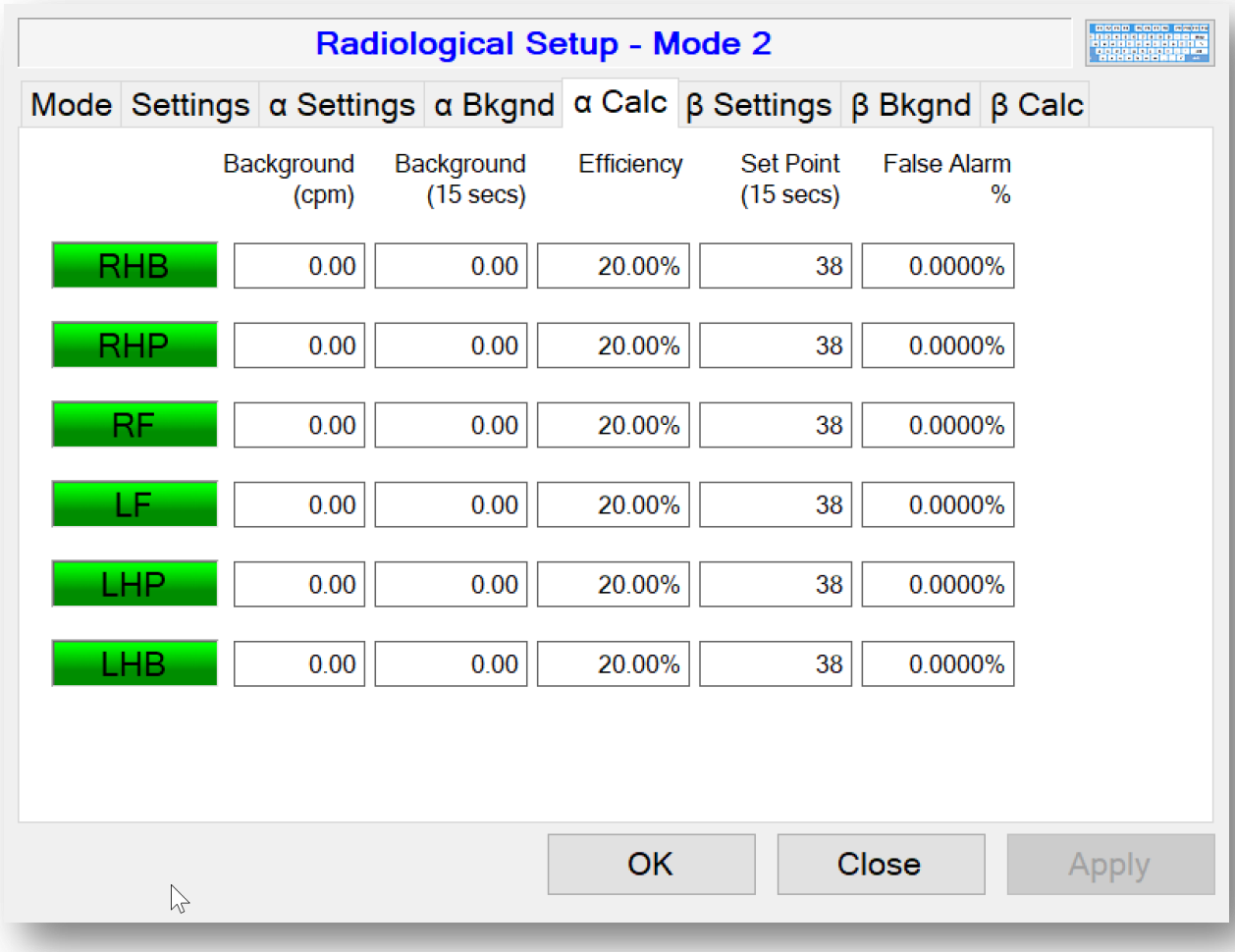
Each detector has a low and high-background alarm set point for all available channels, which are used to identify a detector that is failing. If the background drops below the low set point or goes above the high set point, a detector failure will occur. A low or high-background alarm normally signals a failure of either the detector or its associated preamp electronics. A high background alarm can also warn of some nearby strong source of radiation. Additionally, all alpha channels have a dead detector timer. Due to the low level of alpha background, there may be time intervals in which the alpha background falls to 0. To prevent an alpha low-background alarm in this situation, the alpha low-background alarm level can be set to 0. However, this means that a failure of the alpha channel will not register with a low background alarm. In order to monitor the alpha channel for failure in these conditions, a five-minute dead detector timer is reset every time an alpha count is received. If fifteen consecutive minutes pass with no alpha counts, a low background alarm is sounded for the offending detector. Alpha Low Background alarms should be set to 0.00 with the Alpha Time Out Enabled option set to Yes on the Options tab of the Operational Setup screen for 4906AB units.

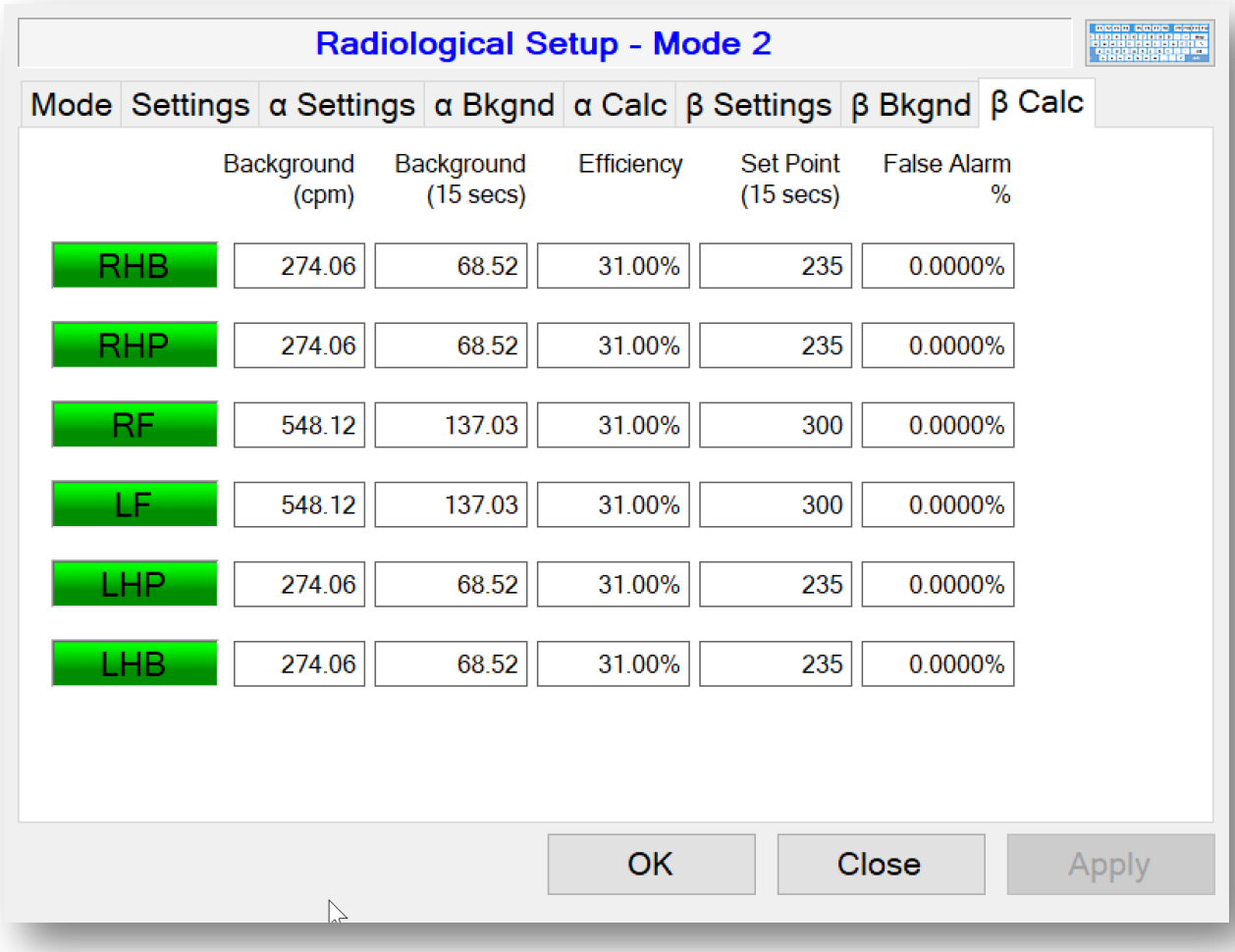

Radiological Setup - Mode 2
Mode
Settings
α Settings
α Bkgnd
α Calc
β Settings
β Bkgnd
β Calc
Alpha Background Low (cpm)
Alpha Background High (cpm)
RHB
0.00
50.00
RHP
0.00
50.00
RF
0.00
50.00
LF
0.00
50.00
LHP
0.00
50.00
LHB
0.00
50.00
OK
Close
Apply



Calculations

The Calculations tab shows the current alarm set point and other values relating to the counting mode. In the far right column, Modes 1 and 3 show the sensitivity and Mode 2 shows the false alarm probability. These values are updated once per second.


Radiological Setup - Mode 2
Mode
Settings
α Settings
α Bkgnd
α Calc
β Settings
β Bkgnd
β Calc
Background (cpm)
Background (15 secs)
Efficiency
Set Point (15 secs)
False Alarm %
RHB 0.00 0.00 20.00% 38 0.0000%
RHP 0.00 0.00 20.00% 38 0.0000%
RF 0.00 0.00 20.00% 38 0.0000%
LF 0.00 0.00 20.00% 38 0.0000%
LHP 0.00 0.00 20.00% 38 0.0000%
LHB 0.00 0.00 20.00% 38 0.0000%
OK
Close
Apply

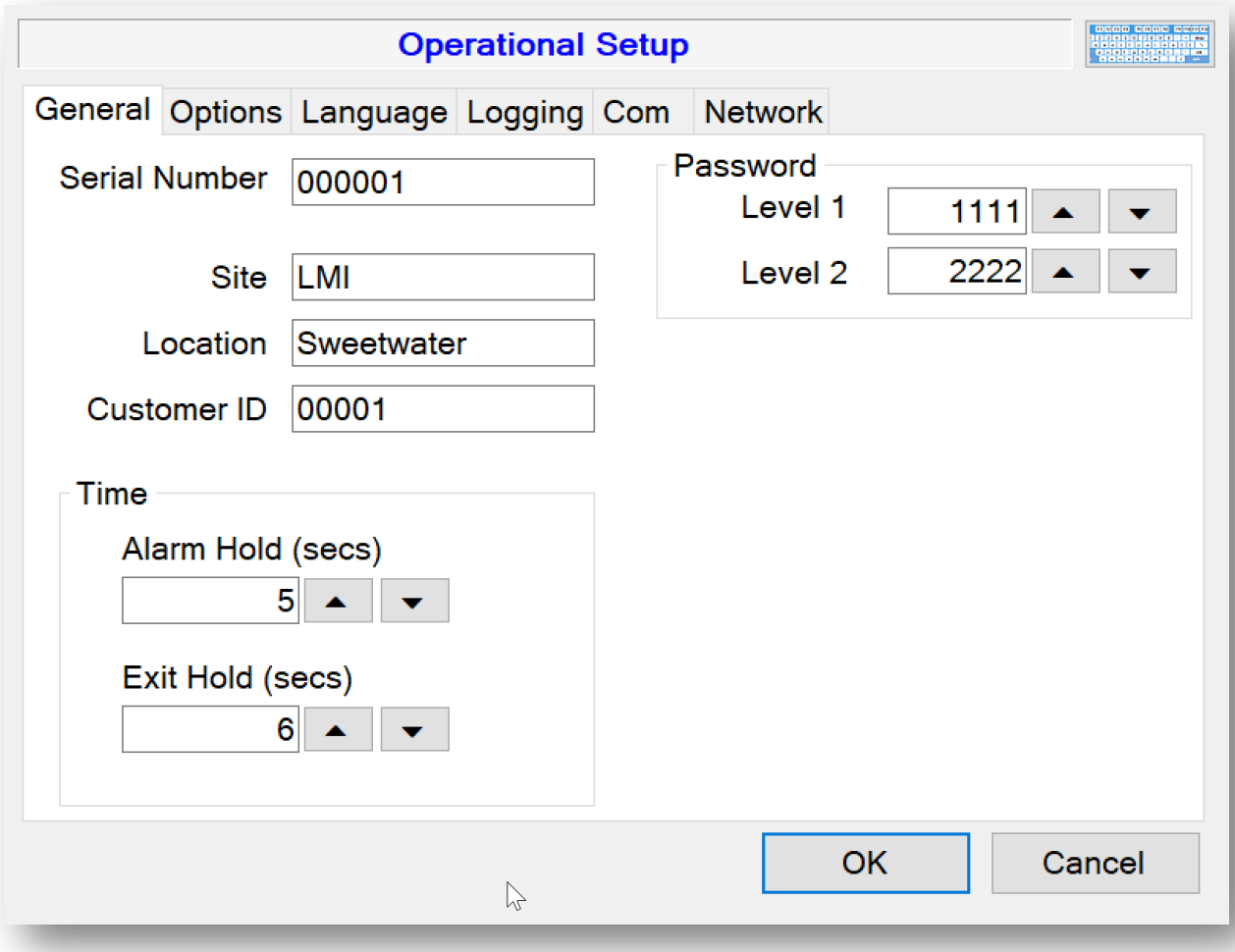

Radiological Setup - Mode 2
Mode
Settings
α Settings
α Bkgnd
α Calc
β Settings
β Bkgnd
β Calc
Background (cpm)
Background (15 secs)
Efficiency
Set Point (15 secs)
False Alarm %
RHB 274.06 68.52 31.00% 235 0.0000%
RHP 274.06 68.52 31.00% 235 0.0000%
RF 548.12 137.03 31.00% 300 0.0000%
LF 548.12 137.03 31.00% 300 0.0000%
LHP 274.06 68.52 31.00% 235 0.0000%
LHB 274.06 68.52 31.00% 235 0.0000%
OK
Close
Apply

Section

10

Operational Setup

The Operational Setup screen is used to configure the various options that define how the Supervisor software operates.



General

Serial Number

This sets the serial number of the Model 4906. This is displayed on the title bar of the Operate screen.

Site

User-defined field is 20 characters in length. The Site is displayed in the title bar of the Operate screen.

Location

User-defined field is 15 characters in length. The Location is displayed in the title bar of the Operate screen.

Customer ID

User-defined field is 10 characters in length. The Customer ID is displayed in the title bar of the Operate screen.

Password

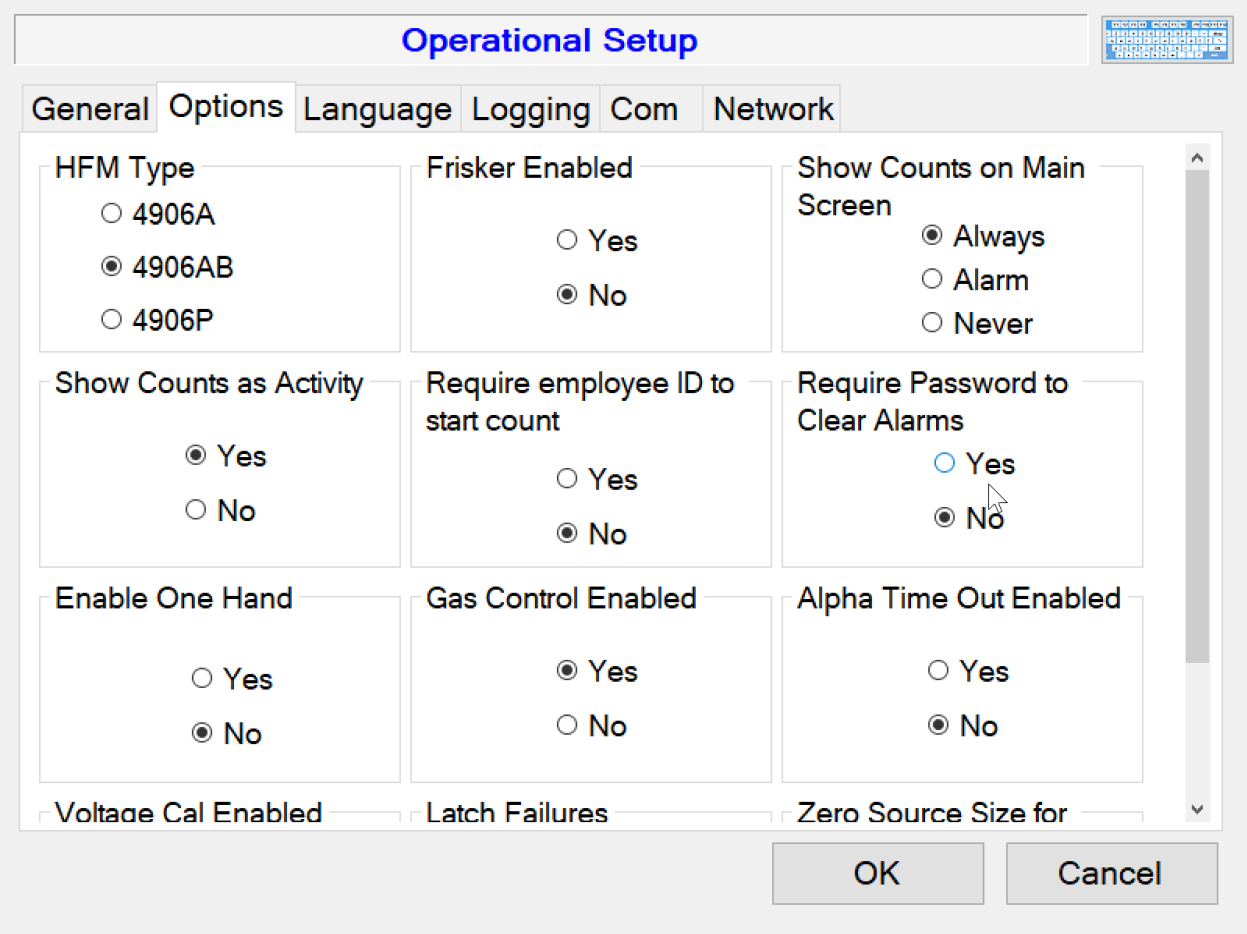
The two-level password is numeric. A Level 1 password does not allow access to the following setup screens: Radiological, Operational, Detectors, Frisker (if equipped), Gas Control (if equipped), False Alarm, Variance/Mean, FOM and Efficiency. A password is required to access the setup menu and to exit/reboot/shutdown the application.

Alarm Hold

Set the number of seconds before the alarm will automatically clear. When the alarm hold time is set to zero, pressing the Acknowledge button once within six seconds of the alarm will silence the audio and pressing it again after six seconds will clear the alarm. When the alarm hold time is greater than zero, pressing once will silence the audio, and pressing again will have no effect.

Exit Hold

This sets the number of seconds to hold at the end of the count to allow the user to exit the monitor. The results of the count cycle will be displayed for this period of time.



Options

HFM Type

This sets the type of hand and foot monitor. The Supervisor supports alpha only (Model 4906A) and alpha and beta (Model 4906AB) and alpha, beta, and gamma (Model 4096P) monitors.

Frisker Enabled

This enables or disables the use of an optional frisker detector.

Show Counts on Main Screen

When enabled, the main screen will display the current counts. The counts are displayed in the detector status indicators.

Show Counts as Activity

When enabled, the main screen will display the current counts in the selected activity units rather than a total sum of the counts. The setting also affects the values saved to the scan log.

Require Employee ID to Start Count

When enabled, the user must enter in an Employee ID before a monitoring cycle can be started. The employee ID is logged in the scan log.

Require Password to Clear Alarms

When enabled, the Level 1 or 2 password is required before the alarm can be cleared.

Enable One Hand

This enables or disables the operation of the ONE HAND button.

Gas Control Enabled

This enables the supervisor gas control functionality. "Yes" should be selected for all systems using gas, rather than air detectors.

Alpha Time Out Enabled

When enabled, a period of 15 minutes without an alpha count on any detector will cause a low background alarm on that detector. This allows the alpha low background alarm to be set at 0.00 and still have a detector failure notice.

Voltage Enabled

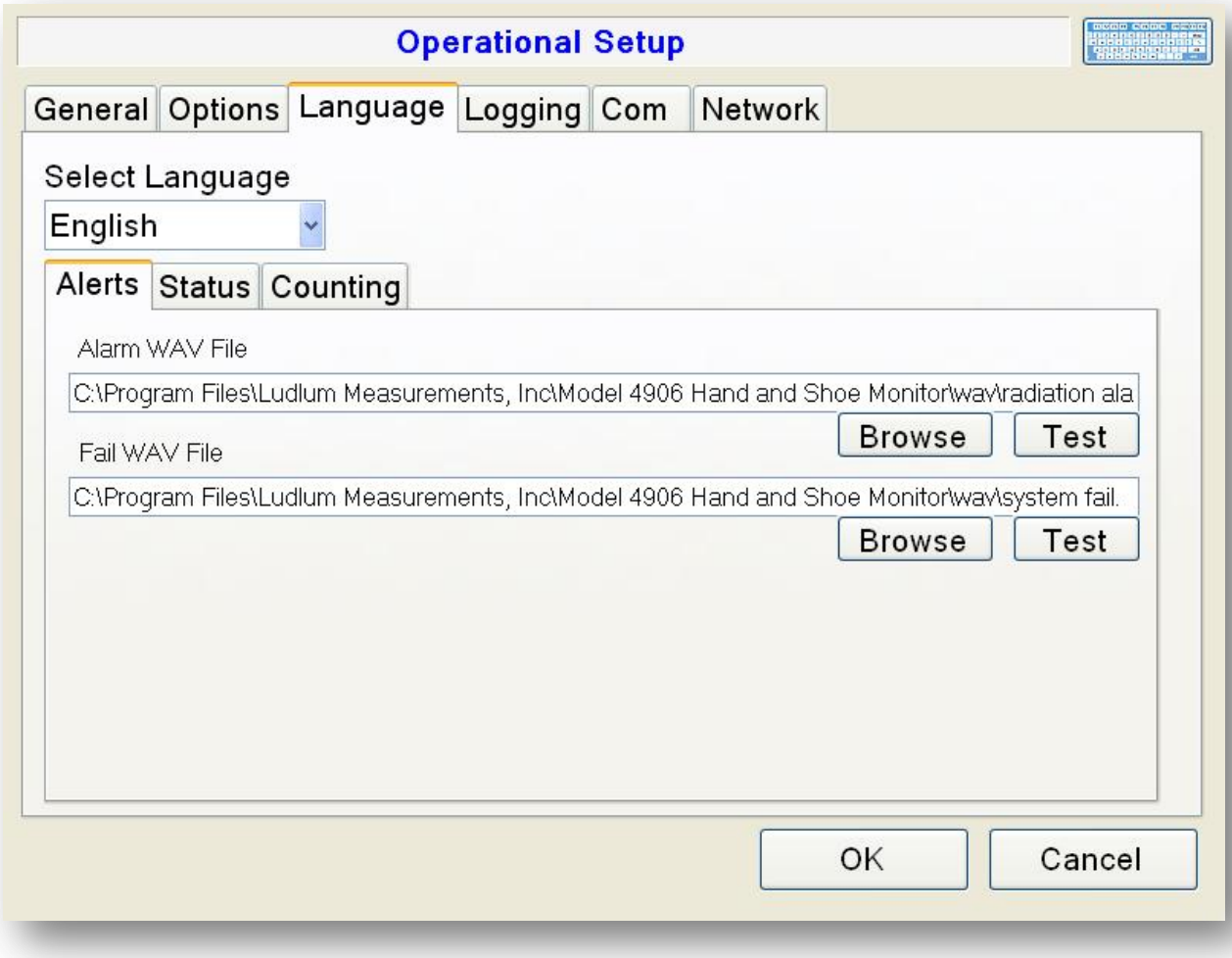
When enabled, it is possible to run through the voltage calibration of the detector boards and set the calibration constants for the HV, LLD, and ULD. This is something that is usually only needed to be done at the factory.

Latch Failures

When enabled, background failures require user intervention, to verify that the detectors are okay and to initiate a new background. When disabled, the system will return to READY automatically when the alarm condition clears.

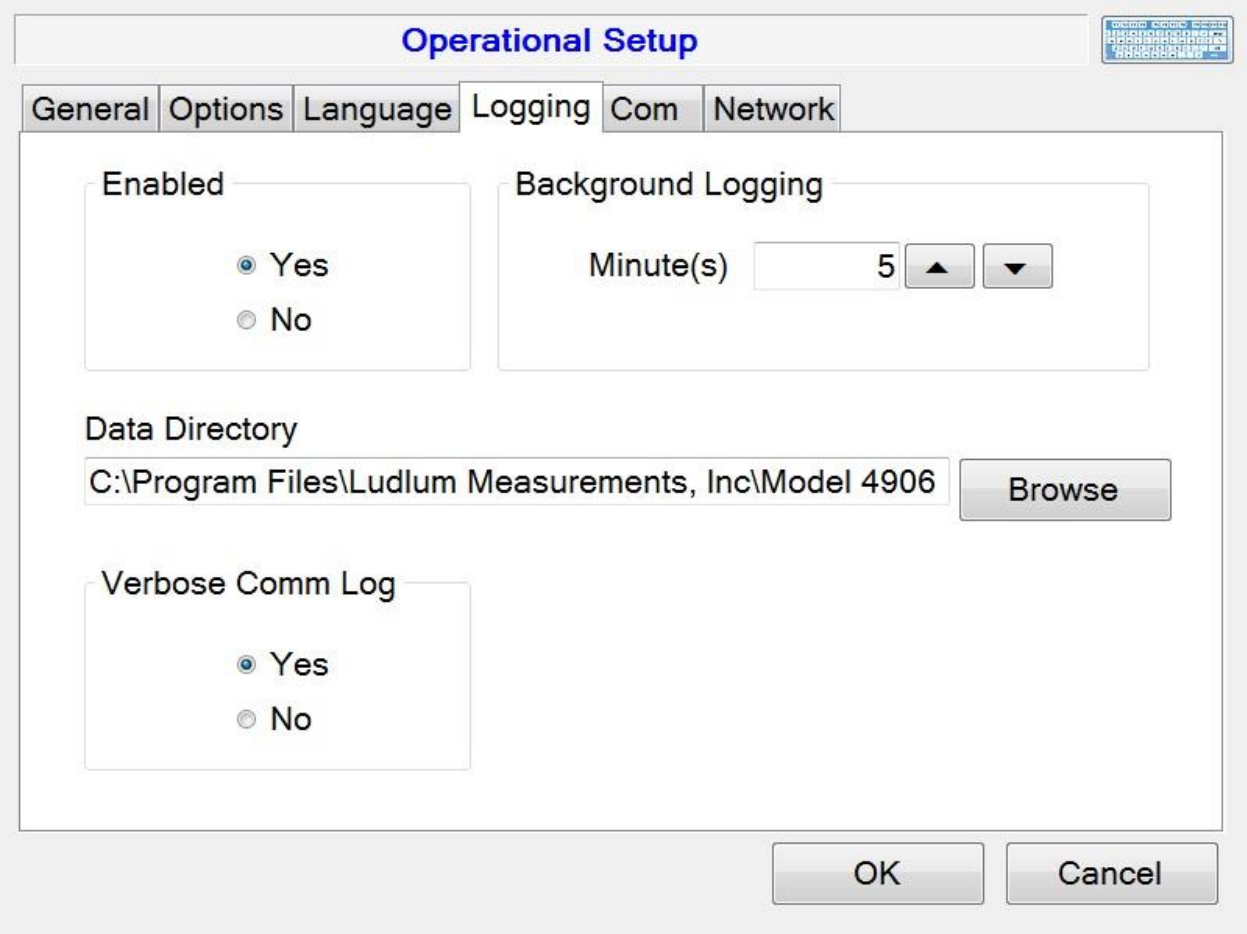
Zero Source Size for Source Check

When enabled, every time the Source Check screen is opened, the Source Size is reset to zero, forcing the user to select the correct source. Otherwise, the source check will fail. When disabled, the system will remember the last used source size.



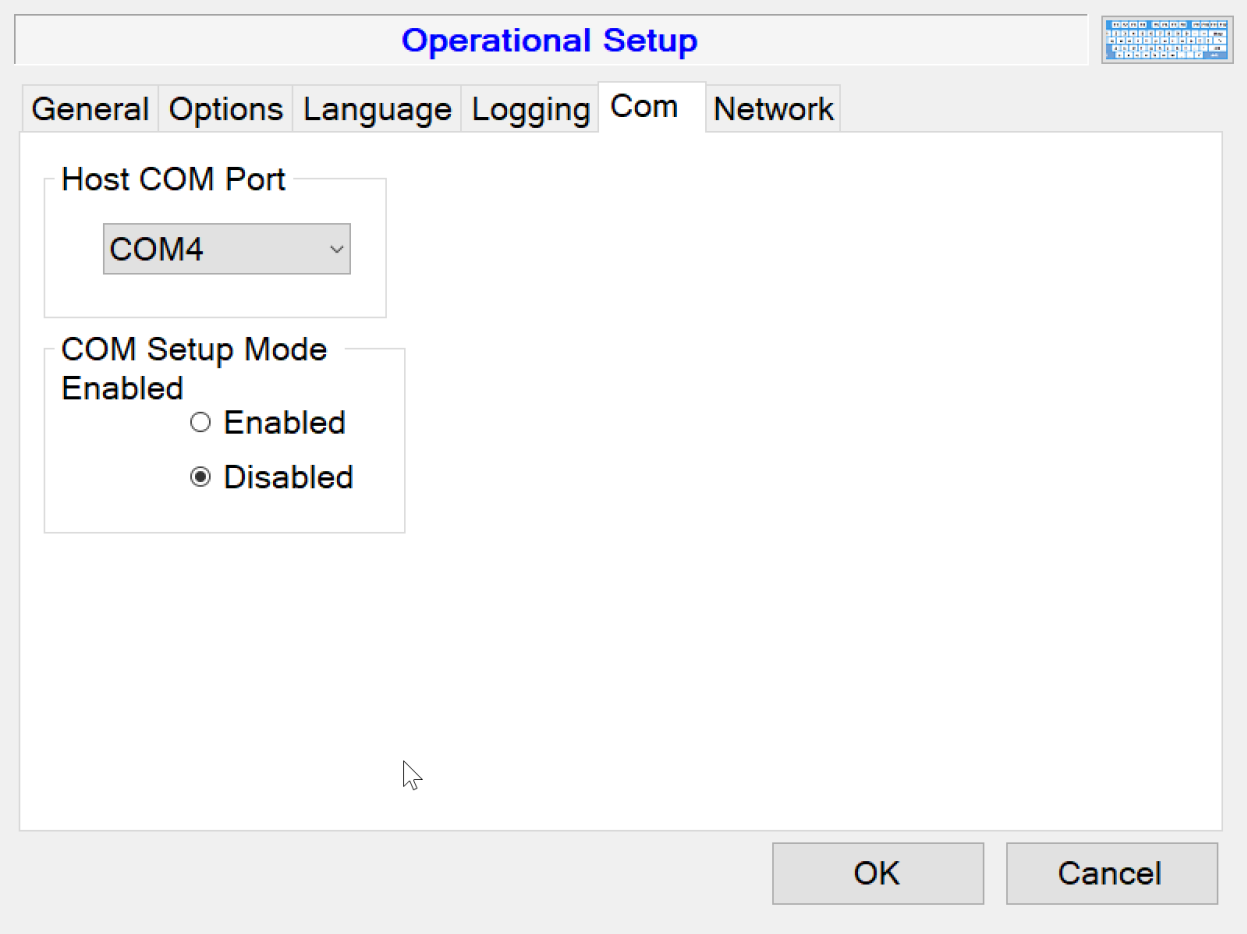
Languages

The Languages tab provides the ability to change the language and customize the voice wav files. Audio files should be in the WAV format and not exceed five seconds in length.



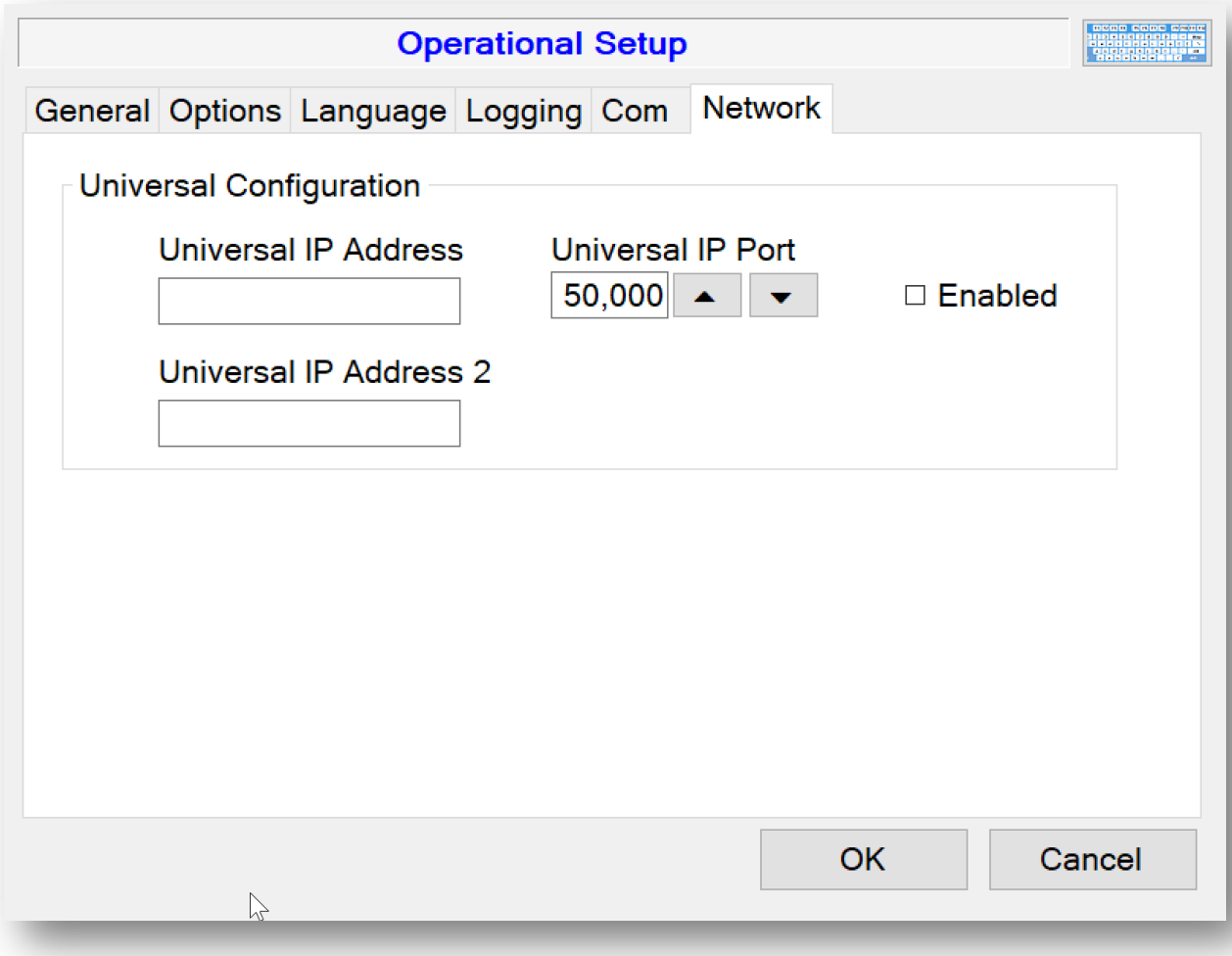
Logging

The logging screen allows the automatic logging to be disabled, sets the path where the log files are stored, and sets the interval that background readings are logged. Additionally, the Verbose Comm Log option allows additional communication data to be logged when desired. Setting this option to Yes will log verbose communication messages to the system log. This option is only recommended for temporary use and should not be left enabled for long periods of time.



Com

The Com screen is used to set the RS-232 com port used by the embedded computer to communicate with the host board. The host board is connected via a USB cable to the embedded computer. Typically this value will never change from the Com port set at the factory. The Comms Setup Mode Enabled option prevents certain communications failures between the SBC and 4906 hardware from triggering a system failure. This mode is primarily available for setup, calibration, and troubleshooting and should not be left on for prolonged periods of time.



Network

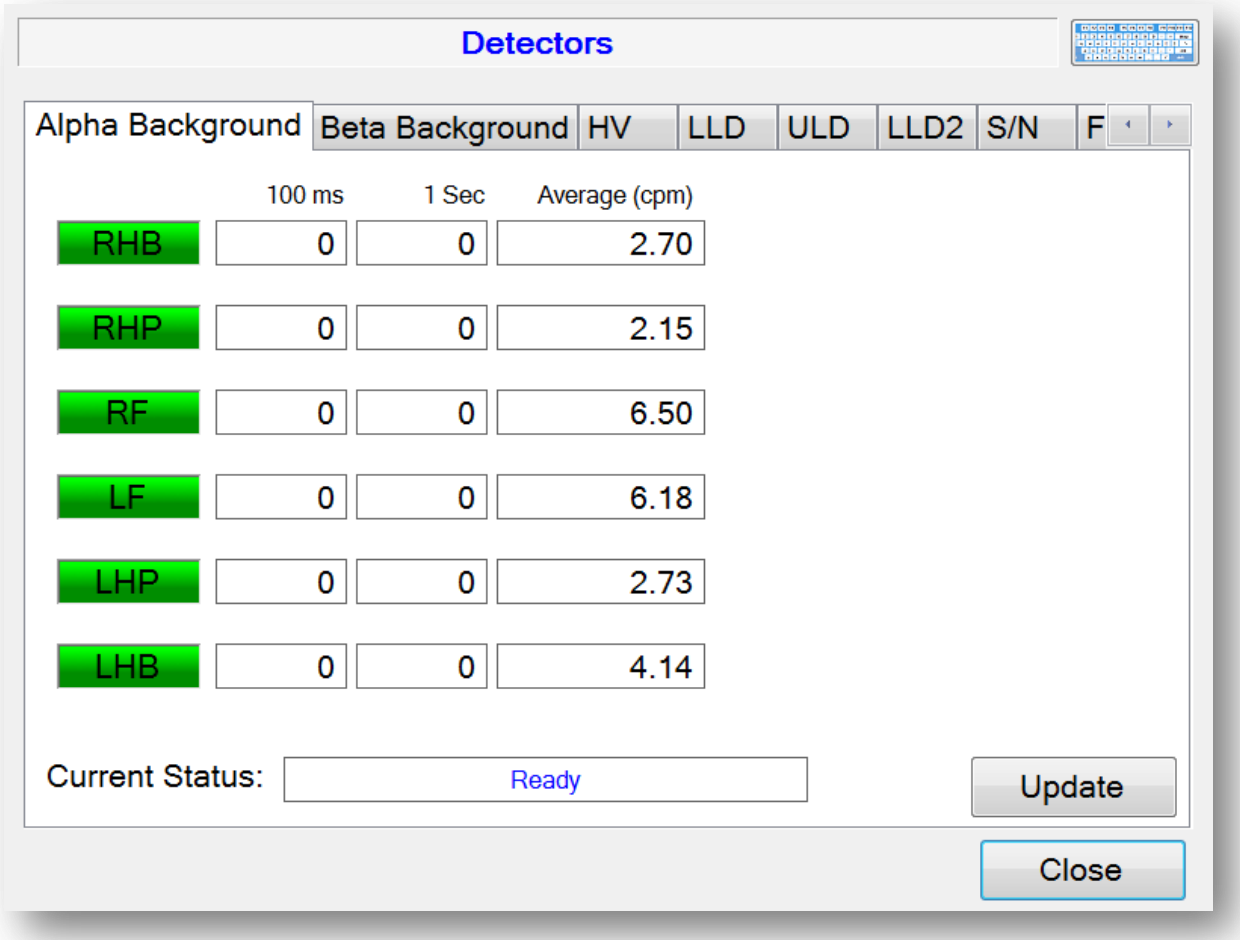
The network tab is used to configure the network settings used by the LMI Collector software. ***This feature is currently not implemented.***

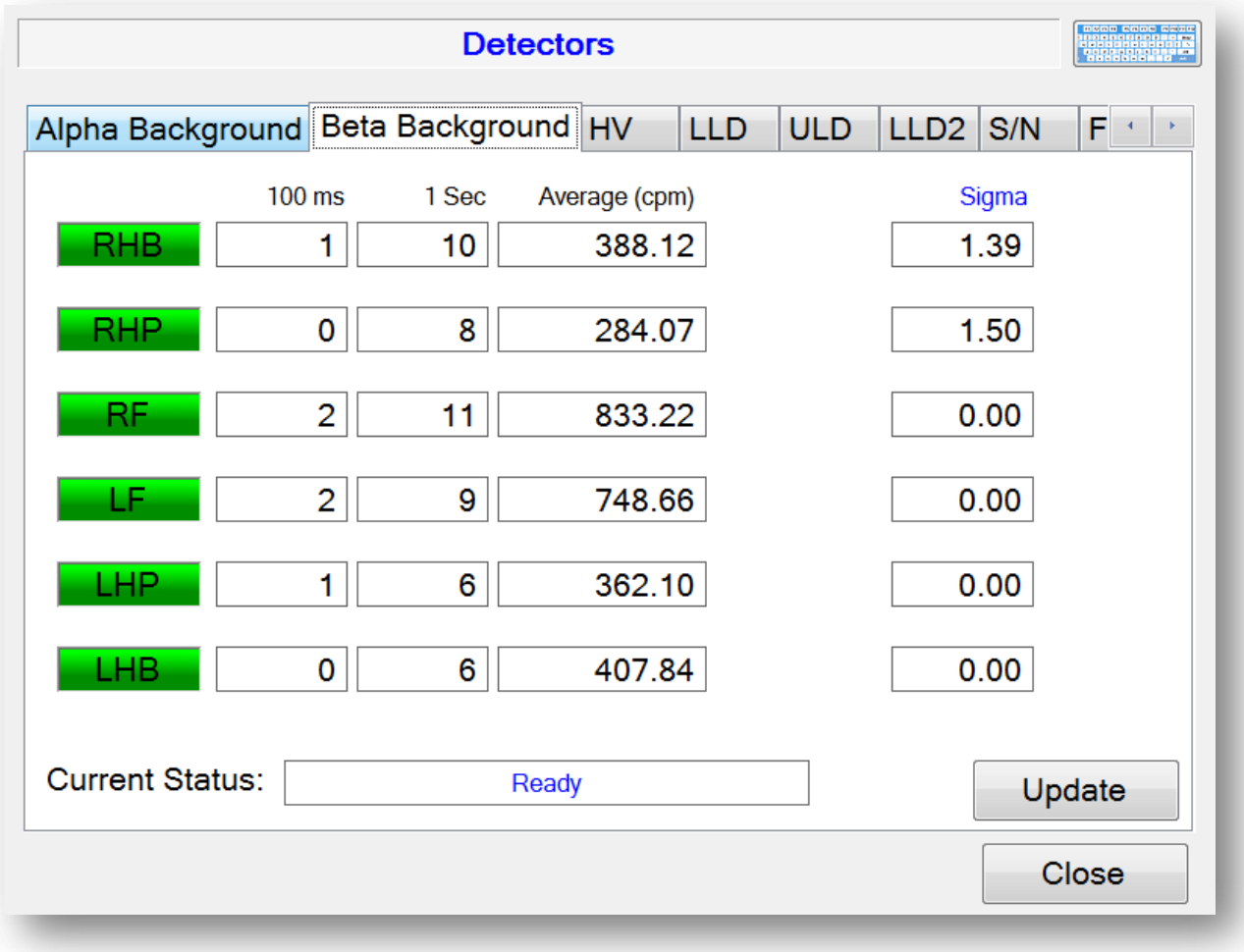
Section 11

Detectors

The Detectors screen is used to view and set the detector's high voltage, lower level discriminator, upper level discriminator, and lower level discriminator 2 (if equipped). The calibration constants can be set through an easy-to-use wizard, which guides the user through the process. The current background readings can also be viewed here.

Background



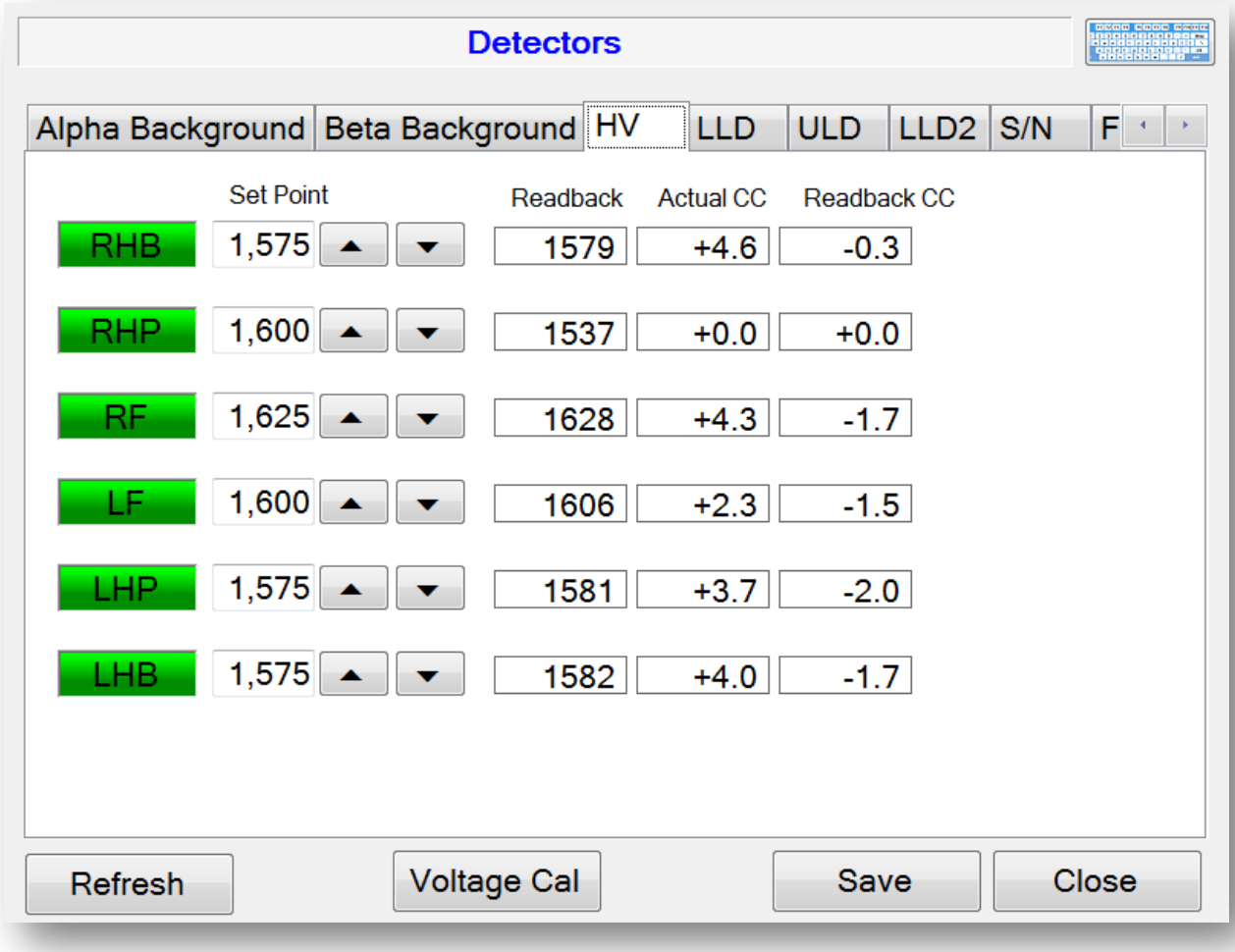


The background screen shows the current background detail for each detector. The status for each detector is displayed using the background color of the detector indicators. Count data is received from the host board every 100 millisecond. These 100-millisecond counts are accumulated together every one second. The Average count is the current background average.

These values only update when the background is updating. The detector indicators will change color to indicate the detector's status with green for OK, yellow for fail, and red for alarm. The current status is displayed at the bottom. Press the Update button to start a new background update cycle.

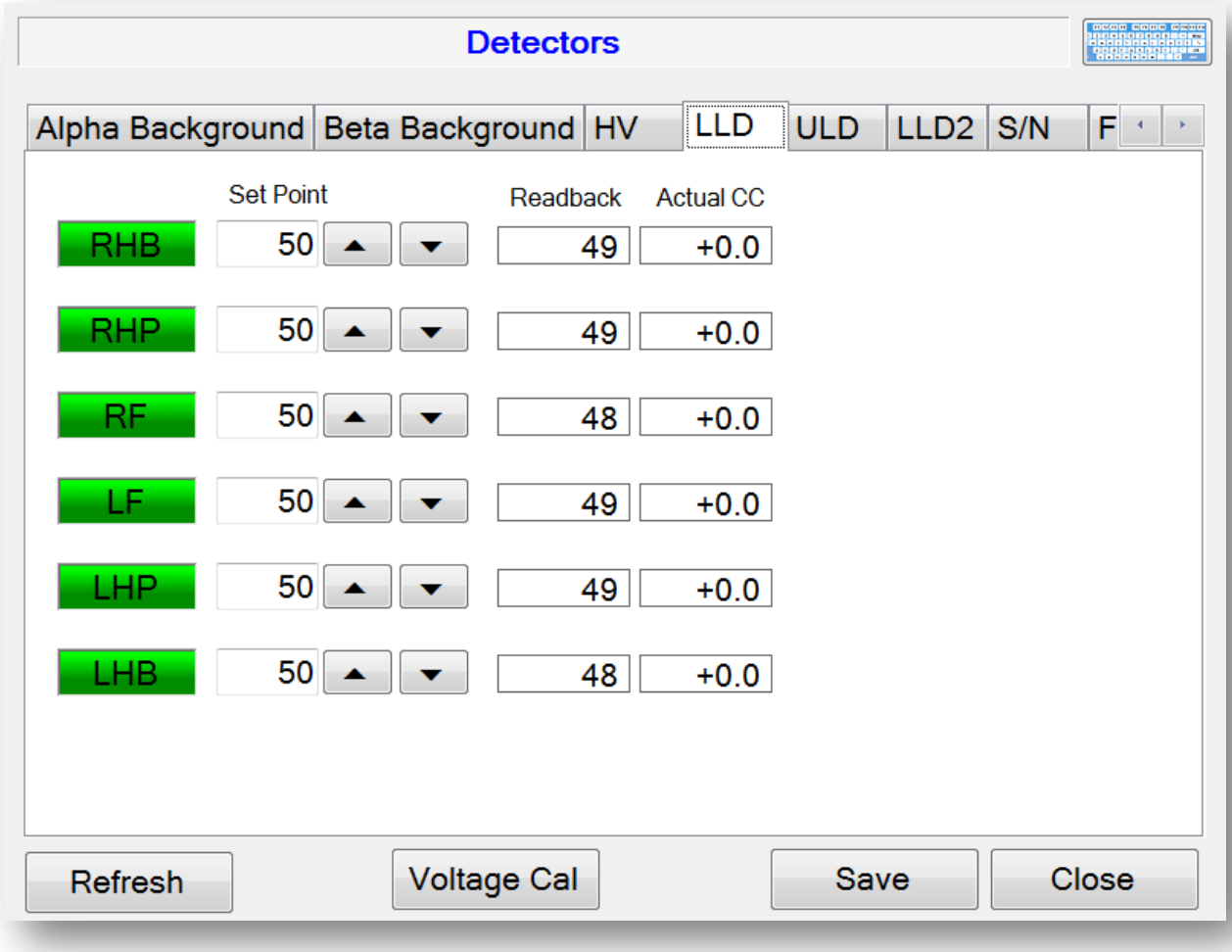
For the beta background an additional sigma value is displayed showing how many sigma away from the average the currently displayed reading was. This value can be used to help determine if Beta Sigma Limit and Beta Sigma OK values in the Radiological setup are set appropriately.

High Voltage (HV)



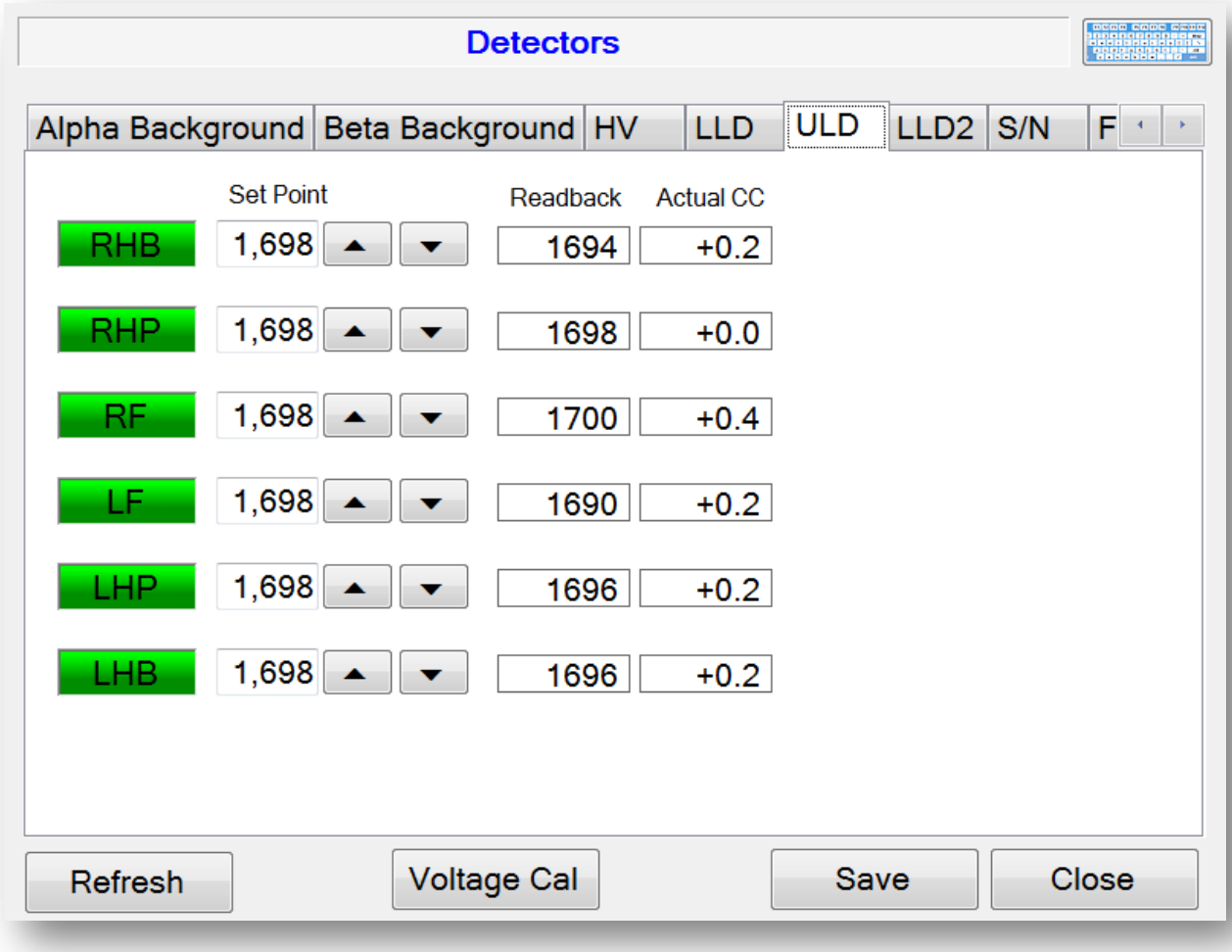
The HV screen displays the current high voltage set point and calibration constants for each detector. High voltage is typically set using the FOM-HV screen. Readback voltage is the value from the A/D converter. There are two calibration constants associated with the high voltage. The Actual calibration constant is used to calibrate the high-voltage output while the readback calibration constant is used to calibrate the readback value from the A/D converter. The high voltage is adjustable from 0 to 2400 V, and the calibration constants are adjustable from -9.9 to +9.9. Click the Refresh button to reload the parameters from all detector boards. After changing the high-voltage set point, click the Save button to apply the changes. The calibration constants can only be changed from the Voltage Calibration Wizard. See below for more information on the Voltage Cal button.

Lower Level Discriminator (LLD)



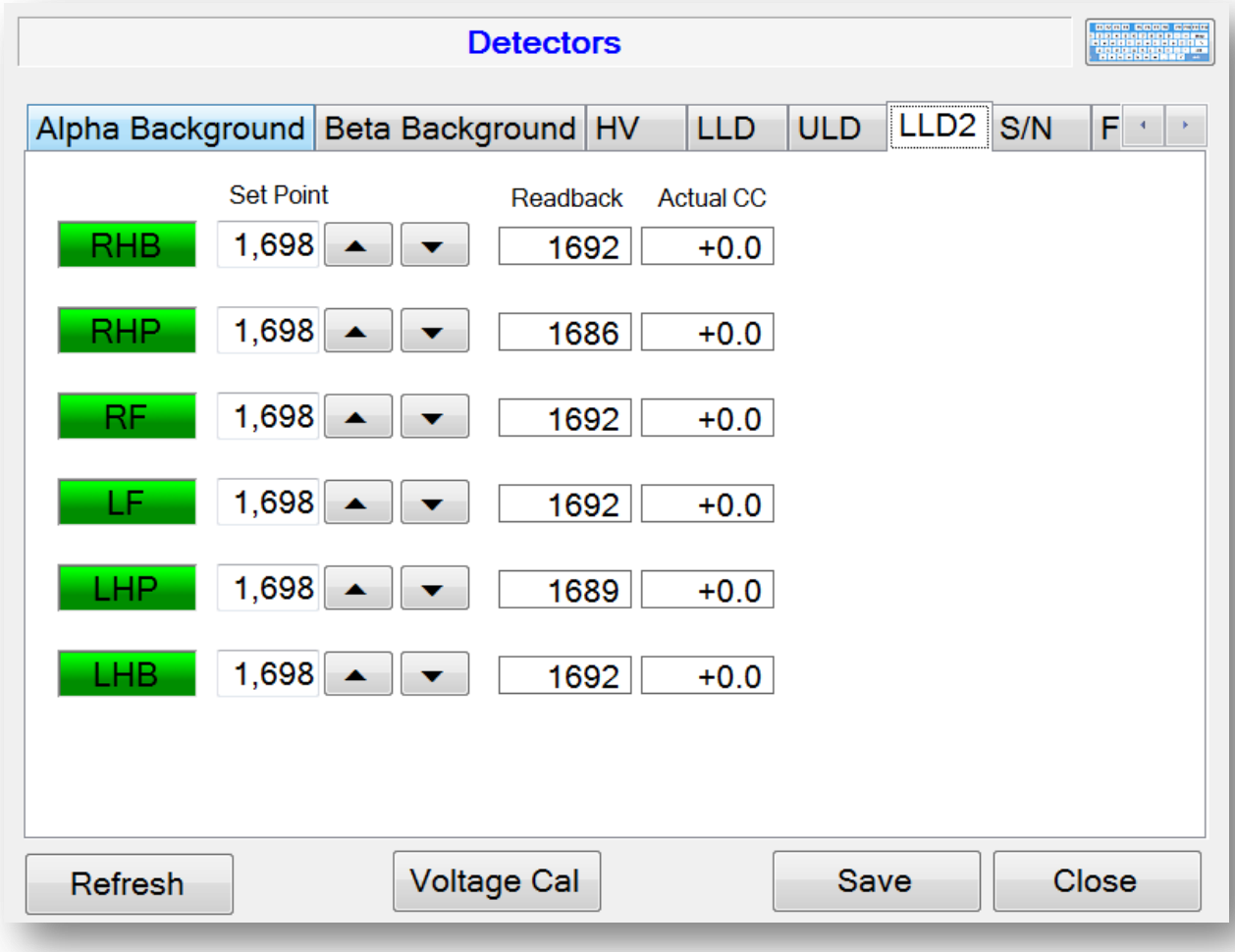
The LLD screen displays the current lower level set point and calibration constant for each detector. Readback is the value from the A/D converter and should be close to the set point. The Actual calibration constant is used to calibrate the LLD output. The LLD is adjustable from 0 to 9999 mV and the calibration constant is adjustable from -9.9 to +9.9. Click the Refresh button to reload the parameters from all detector boards. After changing the LLD set point, click the Save button to apply the changes. The calibration constant can only be changed from the Voltage Calibration Wizard. See below for more information on the Voltage Cal button.

Upper Level Discriminator (ULD)



The ULD screen displays the current upper-level set point and calibration constant for each detector. Readback is the value from the A/D converter and should be close to the set point. The Actual calibration constant is used to calibrate the ULD output. The ULD is adjustable from 0 to 9999 mV and the calibration constant is adjustable from -9.9 to +9.9. Click the Refresh button to reload the parameters from all detector boards. After changing the ULD set point, click the Save button to apply the changes. The calibration constant can only be changed from the Voltage Calibration Wizard. See below for more information on the Voltage Cal button.

Lower Level Discriminator 2 (LLD2)



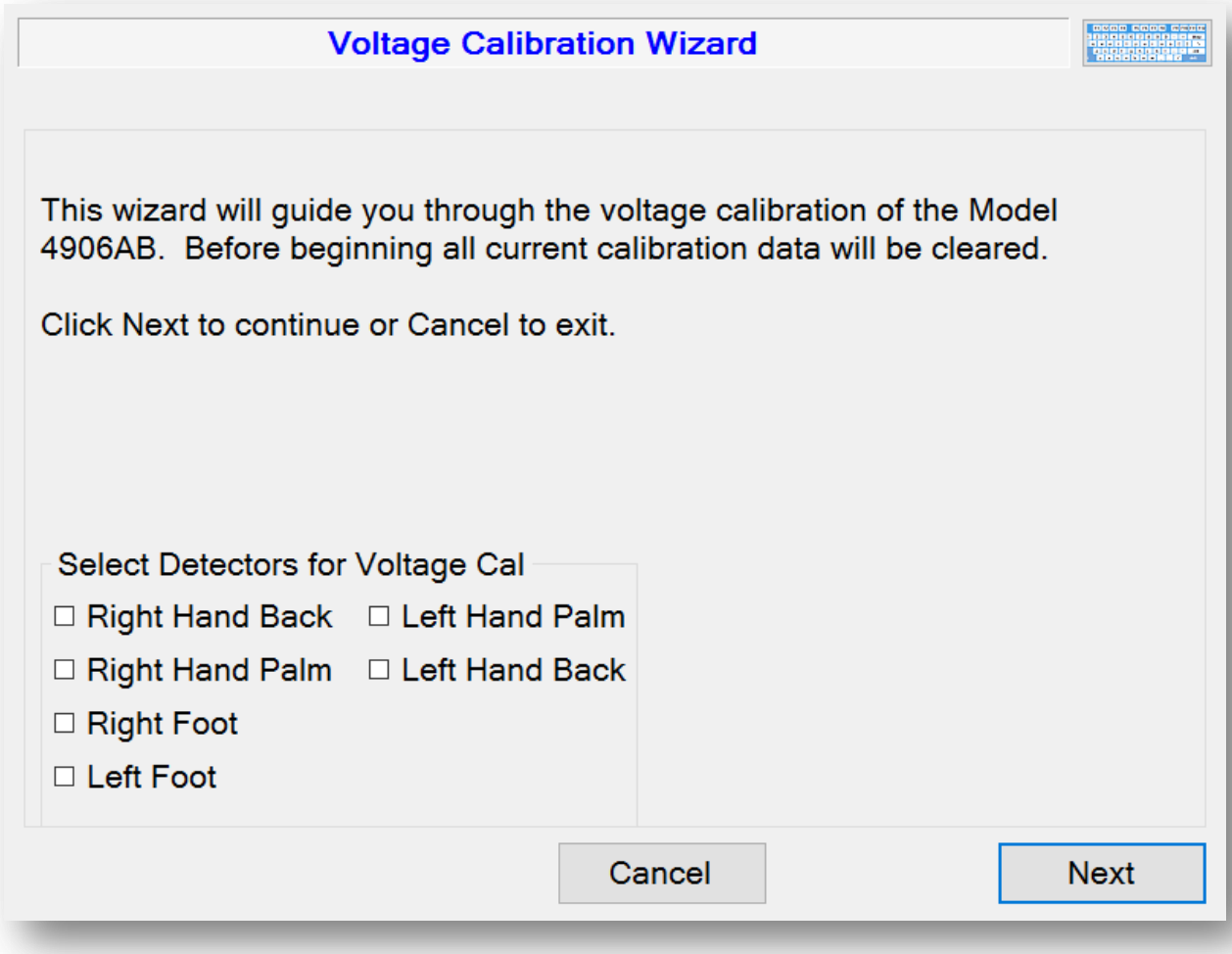
The LLD2 screen displays the current lower-level set point and calibration constant for each detector's alpha channel. Readback is the value from the A/D converter and should be close to the set point. The Actual calibration constant is used to calibrate the LLD2 output. The LLD2 is adjustable from 0 to 9999 mV and the calibration constant is adjustable from -9.9 to +9.9. Click the Refresh button to reload the parameters from all detector boards. After changing the LLD2 set point, click the Save button to apply the changes. The calibration constant can only be changed from the Voltage Calibration Wizard. See below for more information on the Voltage Cal button.

Voltage Calibration

The Voltage Calibration Wizard is accessed through the Voltage Cal button. The wizard guides the user through the process of setting the calibration constants for each detector. If the unit is equipped with a frisker and the Frisker Enabled option is turned on, the frisker detector board will also be calibrated when the Voltage Calibration Wizard is run. The following parameters will be set by the wizard:

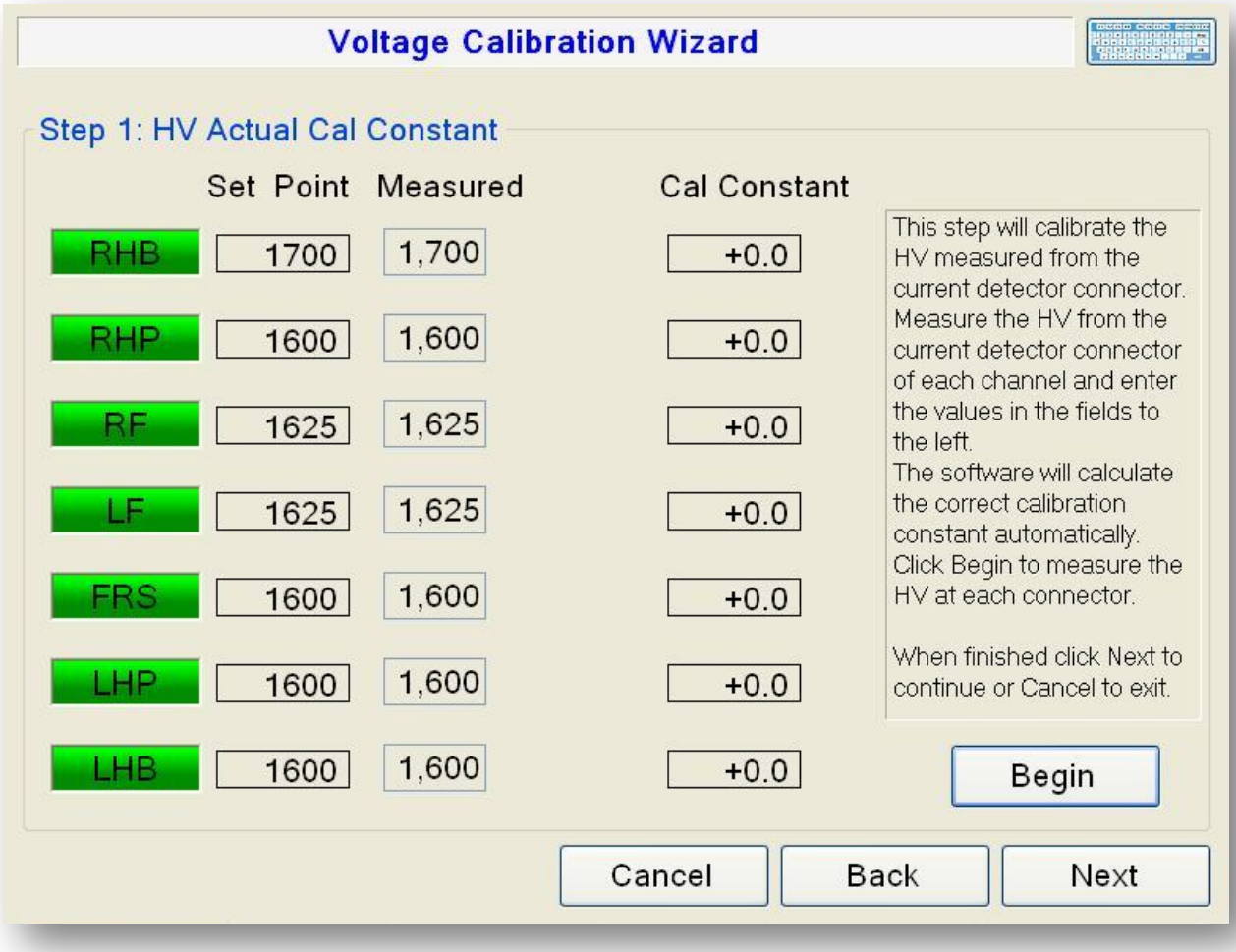
- HV Actual Calibration Constant
- HV Readback Calibration Constant
- LLD Actual Calibration Constant
- ULD Actual Calibration Constant
- LLD2 Actual Calibration Constant (for alpha and beta systems only)

The wizard automatically calculates the calibration constant based on the measurements entered for each detector. All calibration constants are zeroed out at the beginning for the selected detectors. Calibration requires a Model 500 Pulser with high-voltage readout or a high-impedance voltmeter with at least 1000 Mega ohm meter input resistance. Click the Next button to begin the calibration.

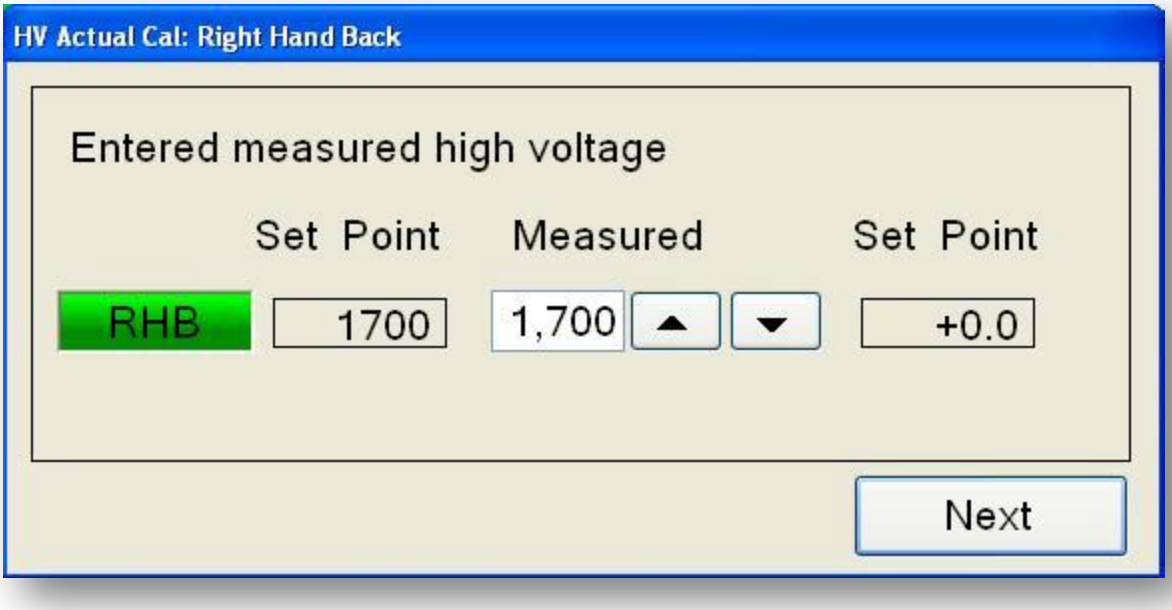


HV Actual Calibration Constant

Click the Begin button to start the process of calibrating the HV Actual Calibration Constant. The calibration constant is calculated automatically by entering the high voltage measured at the detector connector. The wizard will set the high voltage of all detectors to zero and then prompt for the cable to be connected to the first detector. The detector order is: Right Hand Back, Right Hand Palm, Right Foot, Left Foot, Frisker (is equipped), Left Hand Palm, Left Hand Back.

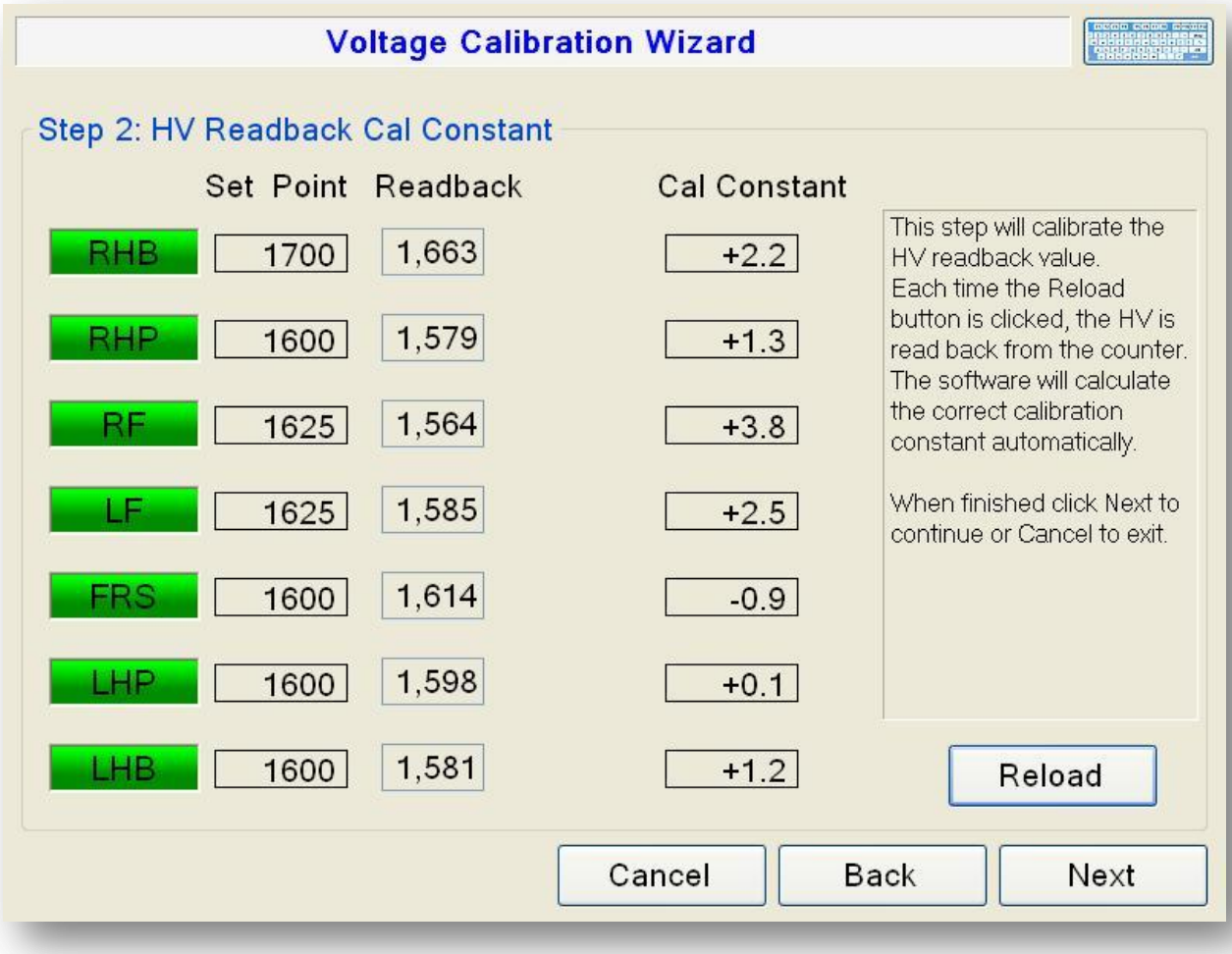

Voltage Calibration Wizard
Step 1: HV Actual Cal Constant
Set Point
Measured
Cal Constant
RHB
1700
1,700
+0.0
RHP
1600
1,600
+0.0
RF
1625
1,625
+0.0
LF
1625
1,625
+0.0
FRS
1600
1,600
+0.0
LHP
1600
1,600
+0.0
LHB
1600
1,600
+0.0
This step will calibrate the HV measured from the current detector connector. Measure the HV from the current detector connector of each channel and enter the values in the fields to the left.
The software will calculate the correct calibration constant automatically.
Click Begin to measure the HV at each connector.
When finished click Next to continue or Cancel to exit.
Begin
Cancel
Back
Next

After connecting the cable and clicking the Next button, the high voltage will be restored to the set point. Enter the measured high voltage and click Next. Continue repeating this process until all detectors are completed.



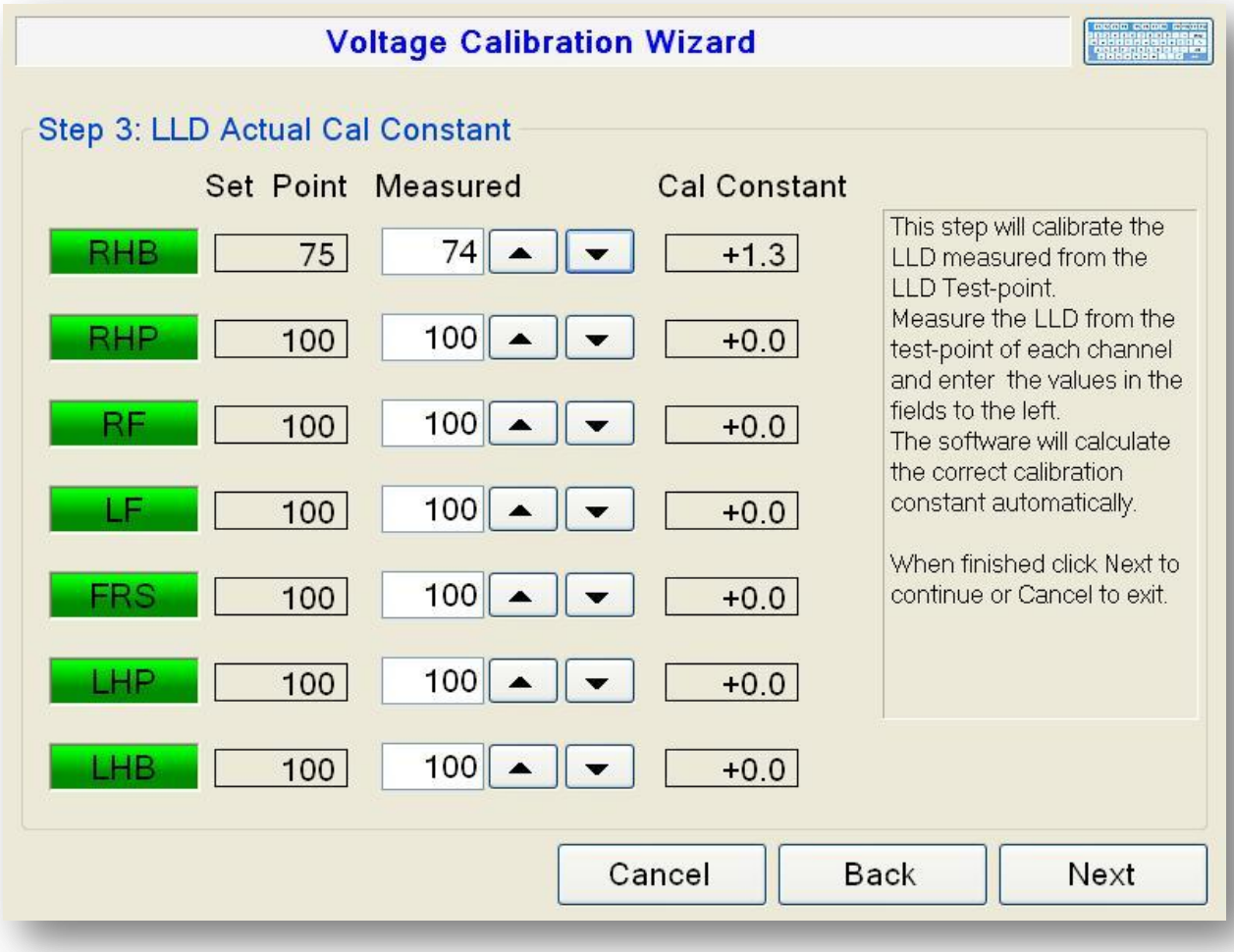
HV Readback Calibration Constant

The calibration of the Readback value is automatic. The wizard will automatically calculate a new calibration constant each time the Reload button is clicked. If the values returned are consistent, click the Next button.



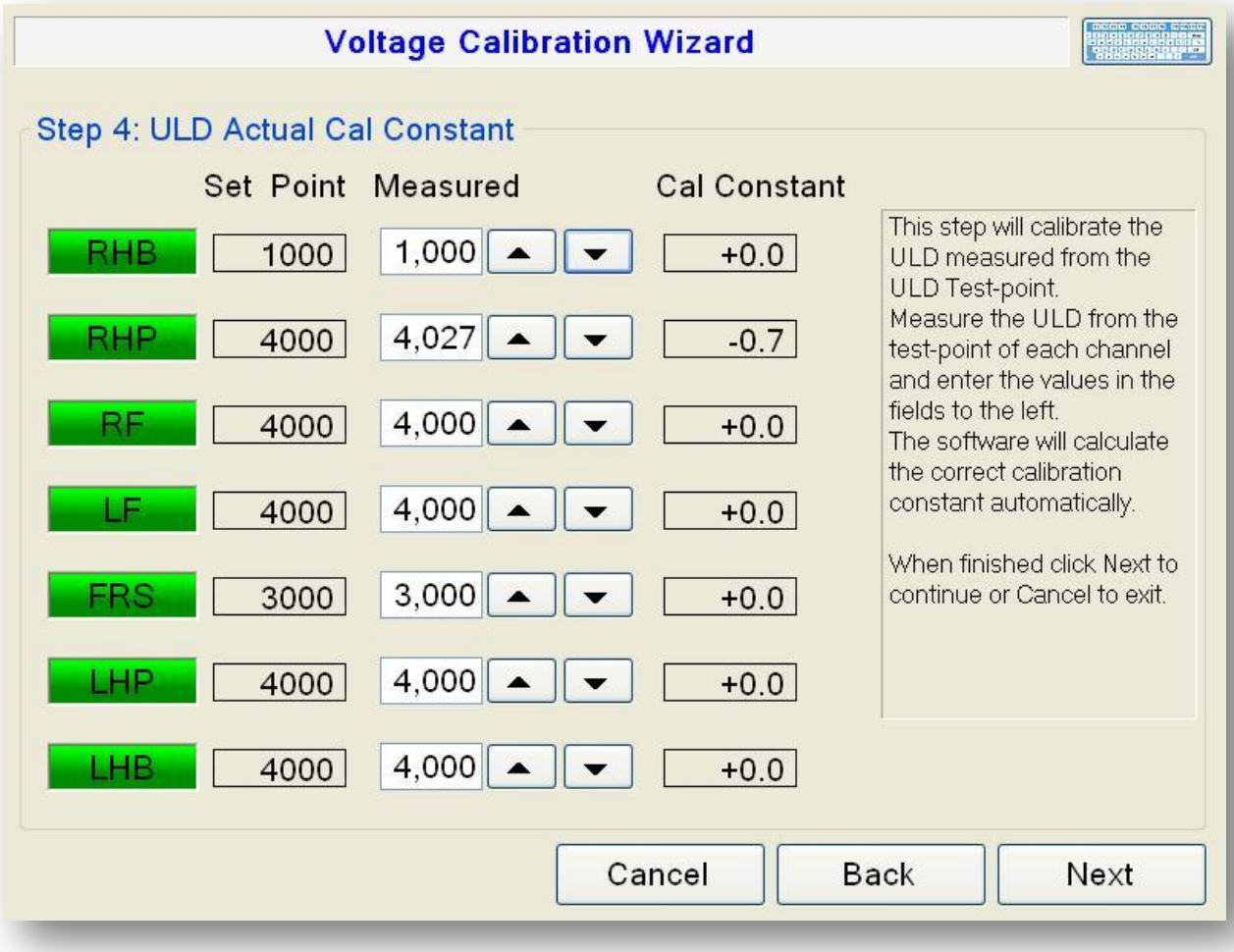
LLD Actual Calibration Constant

The LLD actual calibration constant is obtained by measuring the LLD from the test point on each detector and entering the measured reading in the appropriate field. The calibration constant is automatically calculated. Click the Next button when finished.



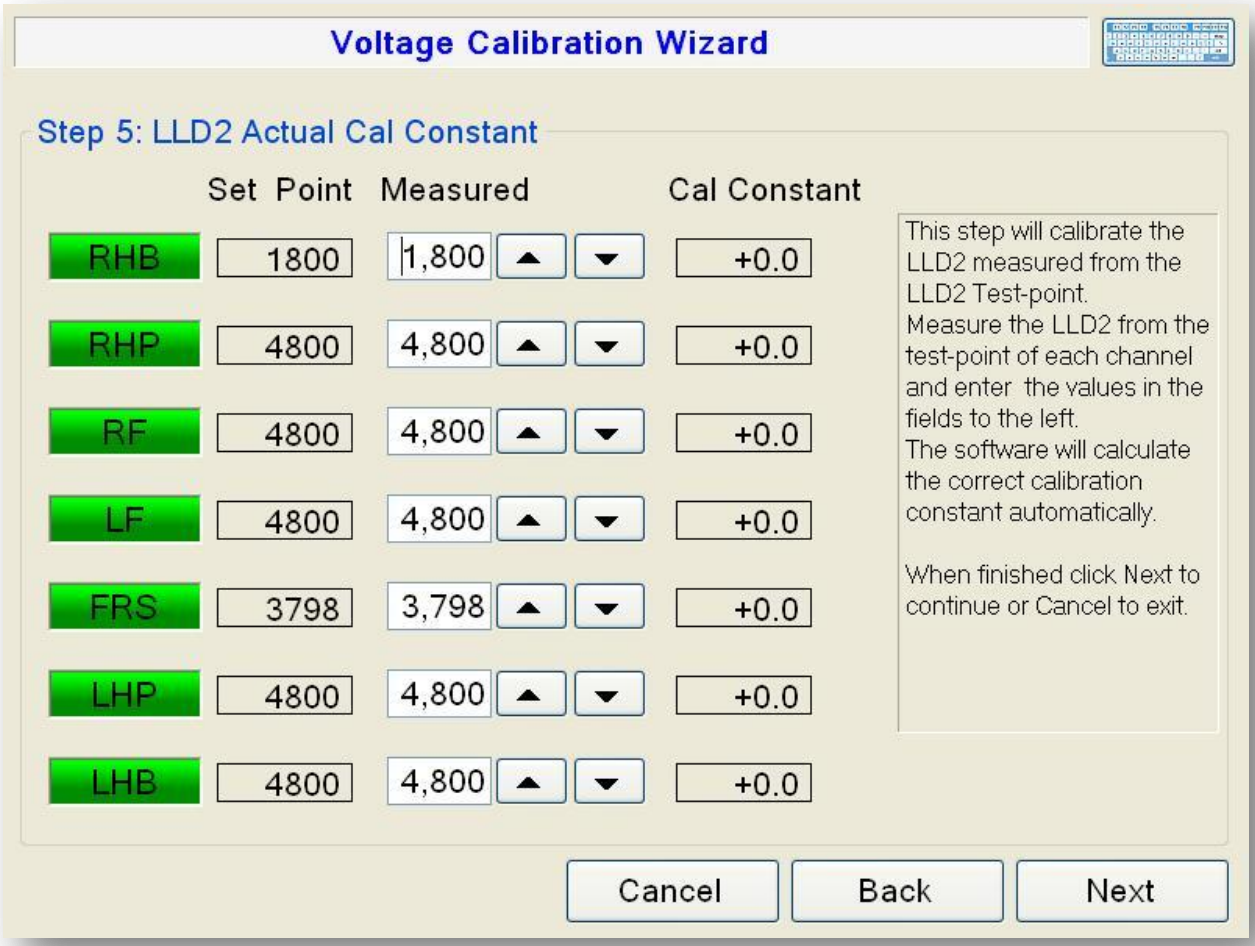
ULD Actual Calibration Constant

The ULD actual calibration constant is obtained by measuring the ULD from the test point on each channel and entering the measured reading in the appropriate fields. When complete, click the Next button.



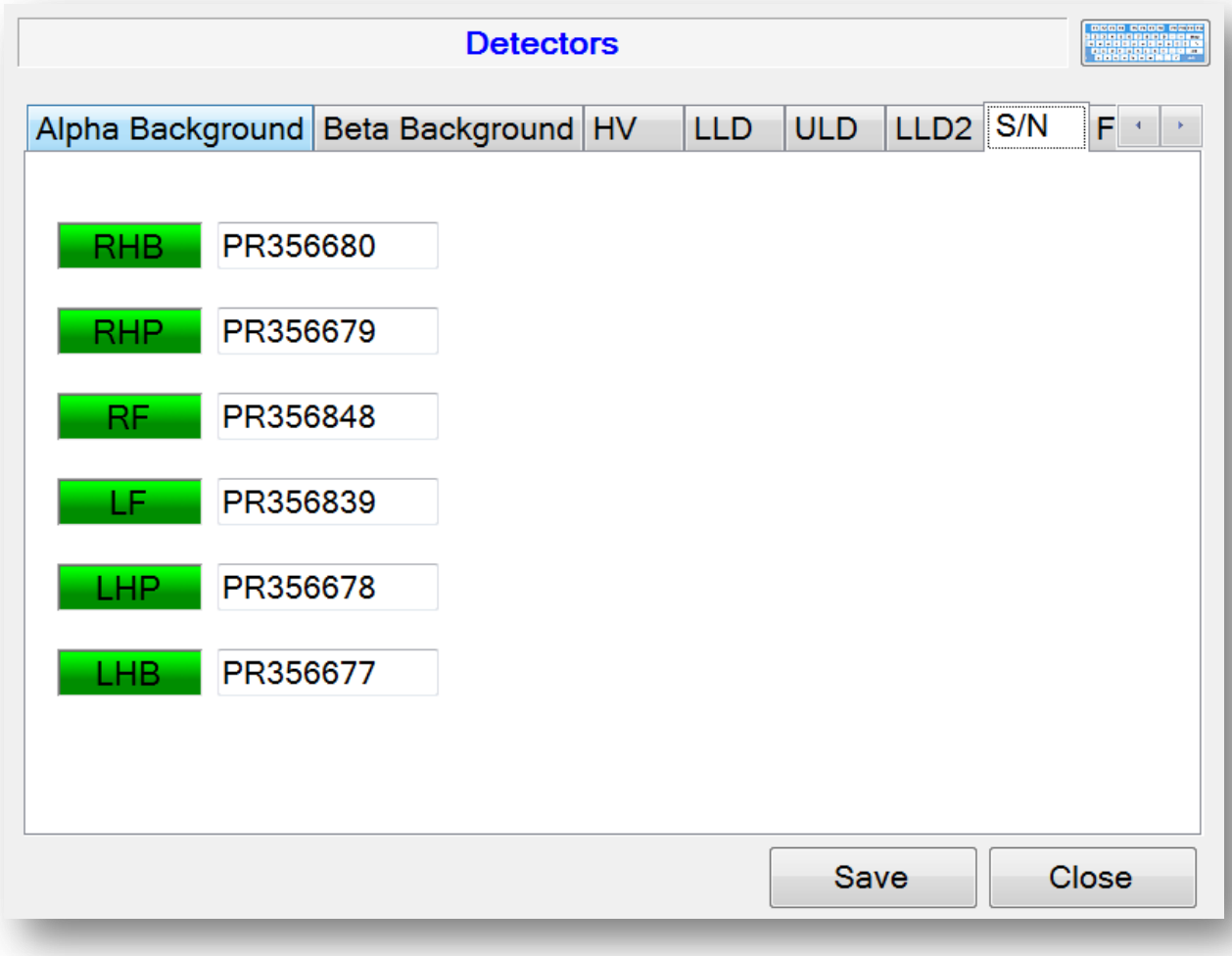
LLD2 Actual Calibration Constant (if equipped)

The LLD2 actual calibration constant is obtained by measuring the LLD2 from the test point on each channel and entering the measured reading in the appropriate fields. When complete, click the Next button.



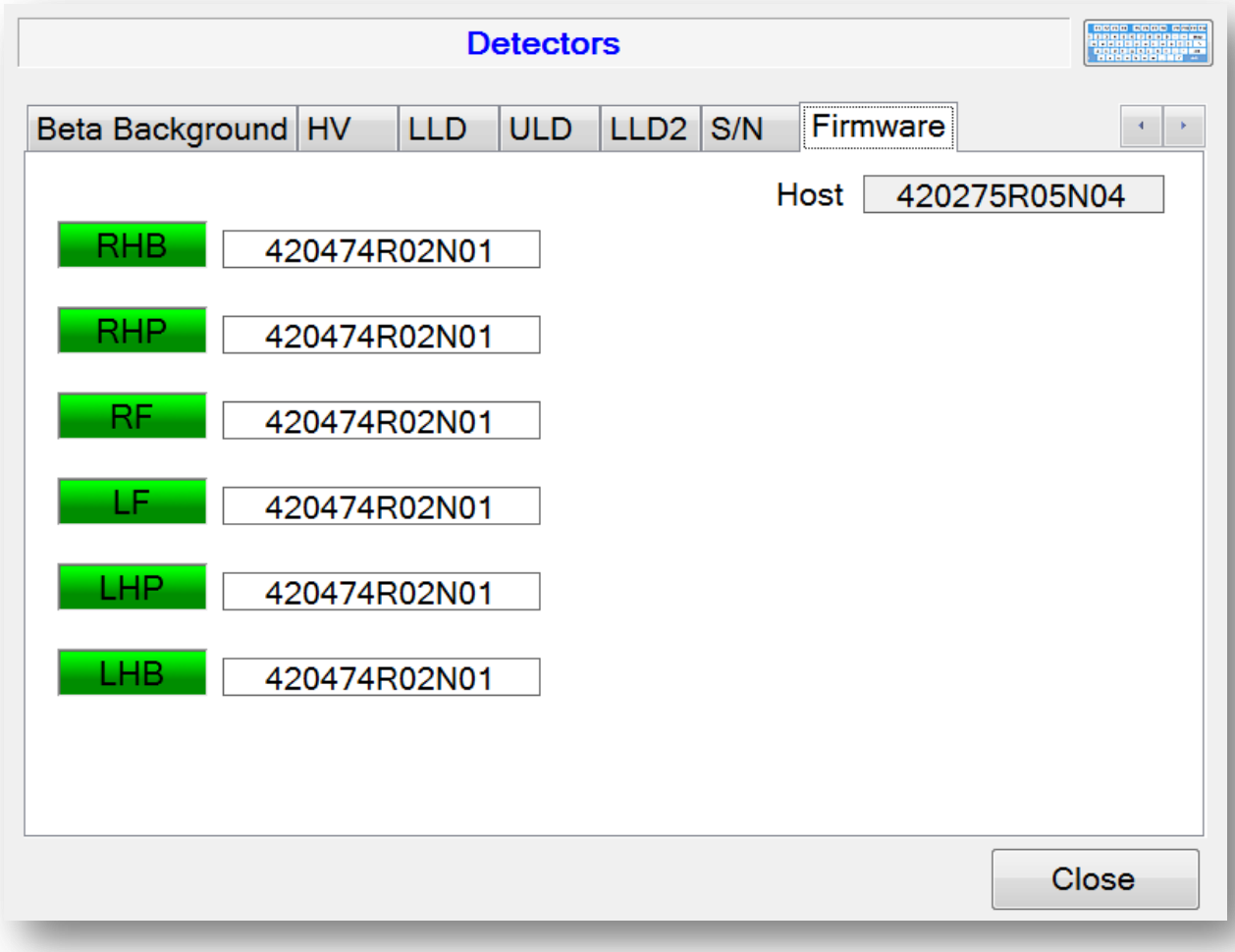
Serial Number (S/N)

The serial number tab displays the serial number of each of the six primary detectors (RHB, RHP, RF, LF, LHP, and LHB). These numbers are entered manually and saved by the supervisor for later viewing and use when generating reports. If a detector is changed or moved, this value must be manually changed to reflect the new detector serial number at each position based on detector markings.



Firmware

The firmware tab displays the firmware version of each of the six primary detector boards (RHB, RHP, RF, LF, LHP, and LHB) and the host board. These firmware versions are read from the detector board by the host board and reported to the supervisor. These values do not require manual entry.

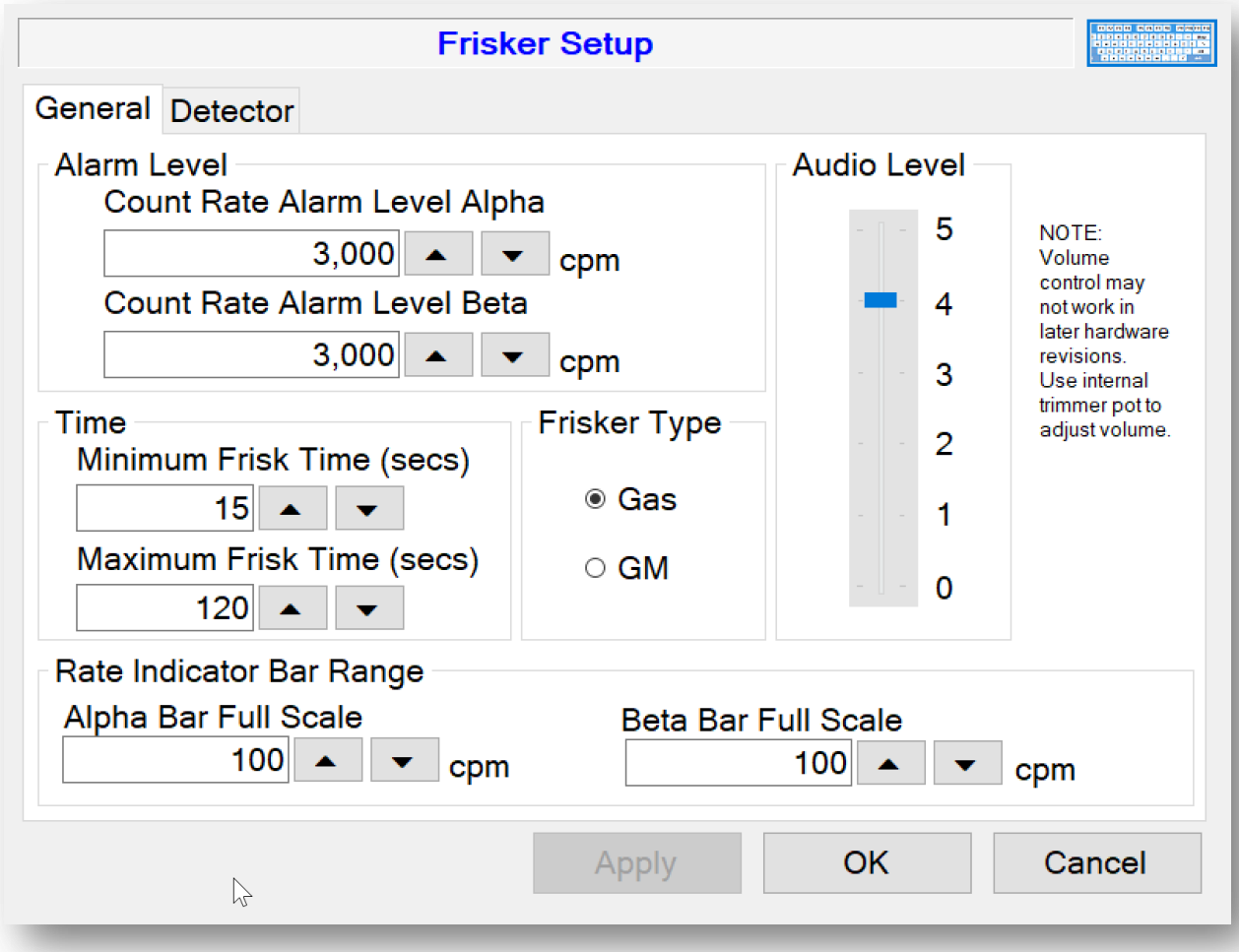

Detectors
Beta Background
HV
LLD
ULD
LLD2
S/N
Firmware
Host
420275R05N04
RHB
420474R02N01
RHP
420474R02N01
RF
420474R02N01
LF
420474R02N01
LHP
420474R02N01
LHB
420474R02N01
Close

Section 12

Frisker

The Frisker screen is used to setup frisker alarm levels, count times, and display preferences, as well as set the frisker detector board high voltage and discriminator levels. The Frisker screen is only available on systems that have the Frisker Enabled option turned on.

General Frisker Settings



The General Frisker tab allows the setting of basic values that govern frisker operation. These values include the frisker Alarm Level, Audio Level, Time requirements, Frisker Type and Count Rate Indicator Bar Range.

The Frisker Type allows the designation of the frisker as Gas (Model 43-143) or Geiger-Mueller (GM Model 44-9). When Gas is selected, the frisker is set up for both alpha and beta channel operation, while selection of the GM option limits the frisker to single channel operation.

Alarm Level sets the count rate at which the frisker will alarm. A different alarm level can be set for each channel in multiple channel systems. The count rate bars turn red, and the red light stack light is illuminated when this level is being actively violated while frisking. Once the frisker is returned to the hook, if this level was exceeded at any time during the frisking process, an alarm will sound.

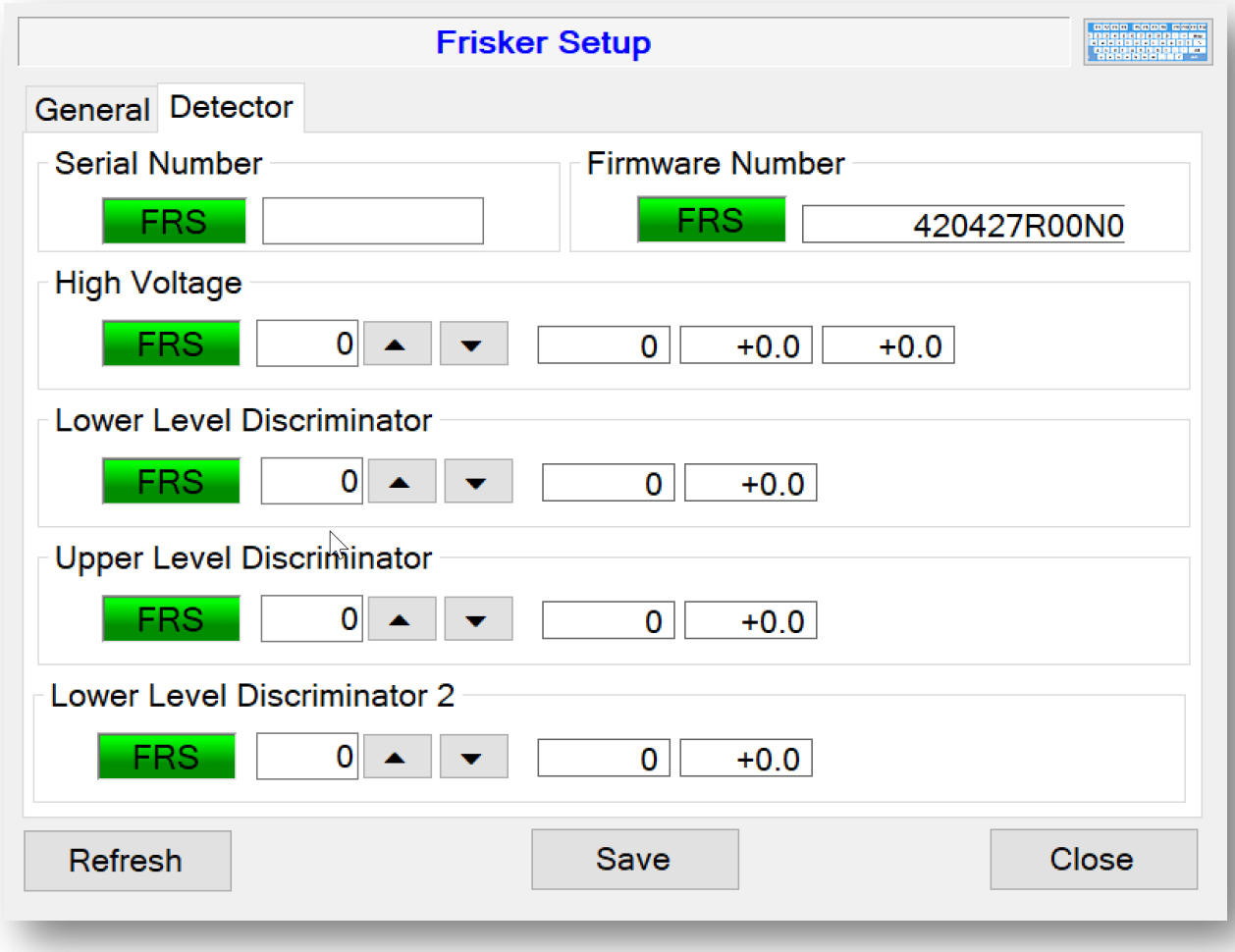
The Time settings allow the user to select a minimum and maximum frisk time. If the minimum frisk time is set to zero, the standard three-second delay given after the frisker is removed from the hook before counting starts is eliminated, and no frisking counts will be considered incomplete. Otherwise, the frisker must be off of the hook for the minimum frisk time before being returned, or a count incomplete indication will be given. The maximum frisk time is primarily used as a tool to detect potential frisker sensor failure. If the frisker sensor does not indicate the frisker is on the hook for a time interval equal to the Maximum Frisk Time, the frisker screen will stop counting and display a message indicating the frisker must be returned to the hook.

The Rate Indicator Bar Range allows adjustment of the count rate indicator bar scaling that is displayed on the Frisker Active screen. The bar can be adjusted to provide a better indication range depending on the alarm set points.

The frisker Audio Level adjustment allows increasing or decreasing the volume of the frisker "click" that is sounded each time a count is received. The audio level can vary from 0 (no sound) to 5 (maximum volume). Normally the frisker audio clicks are turned off unless the frisker is removed from the hook, but the audio is turned on when this screen is opened to allow the user to hear the selected audio level. Once a new audio level have been selected, allow a brief delay for the volume to adjust as some audio circuit capacitors need to charge or discharge before becoming steady at the newly selected level. Frisker Audio Level changes are immediately saved and require no use of the Apply button.

Apply, OK, and Cancel buttons work identically to those on the Radiological setup screen.

Frisker Detector Settings



The Detector Frisker tab allows setup of the frisker voltage levels and display of the frisker serial number and firmware version. As with the other detectors, the serial number must be manually entered while the firmware version is determined via communication with the frisker detector board.

High Voltage, LLD, ULD, and LLD2 can be set by entering the desired value and clicking the Save button. To view updated voltage level information, click the Refresh button. The Close button exits the Frisker Setup screen and does not save new voltage levels.

Section 13

Gas Control

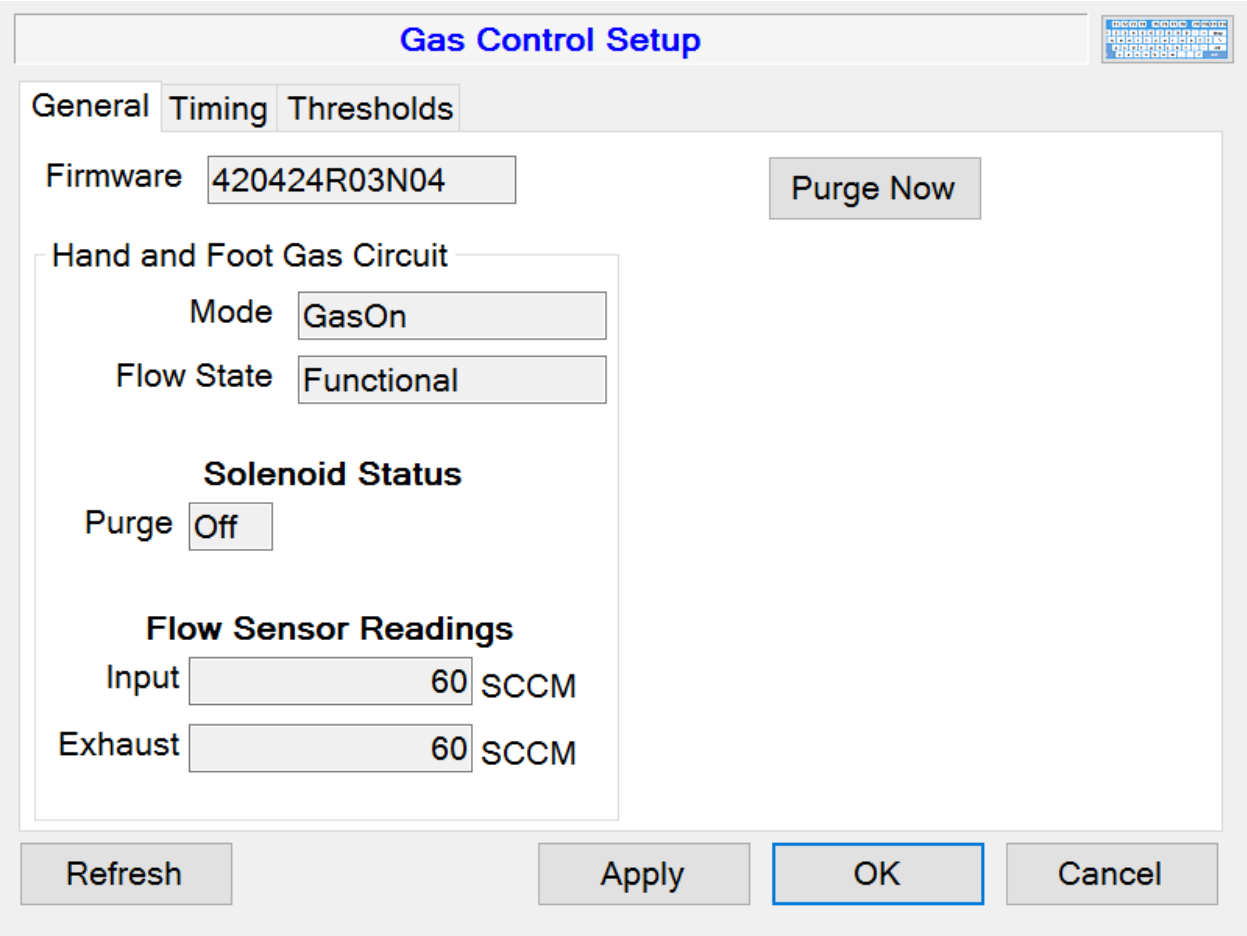
The Gas Control screen allows setup and monitoring of the gas flow and gas flow controller for Model 4906 HFM units equipped with such a system. From this screen, gas flow can be monitored; threshold values can be set; and the gas controller can be set to initiate a gas purge.

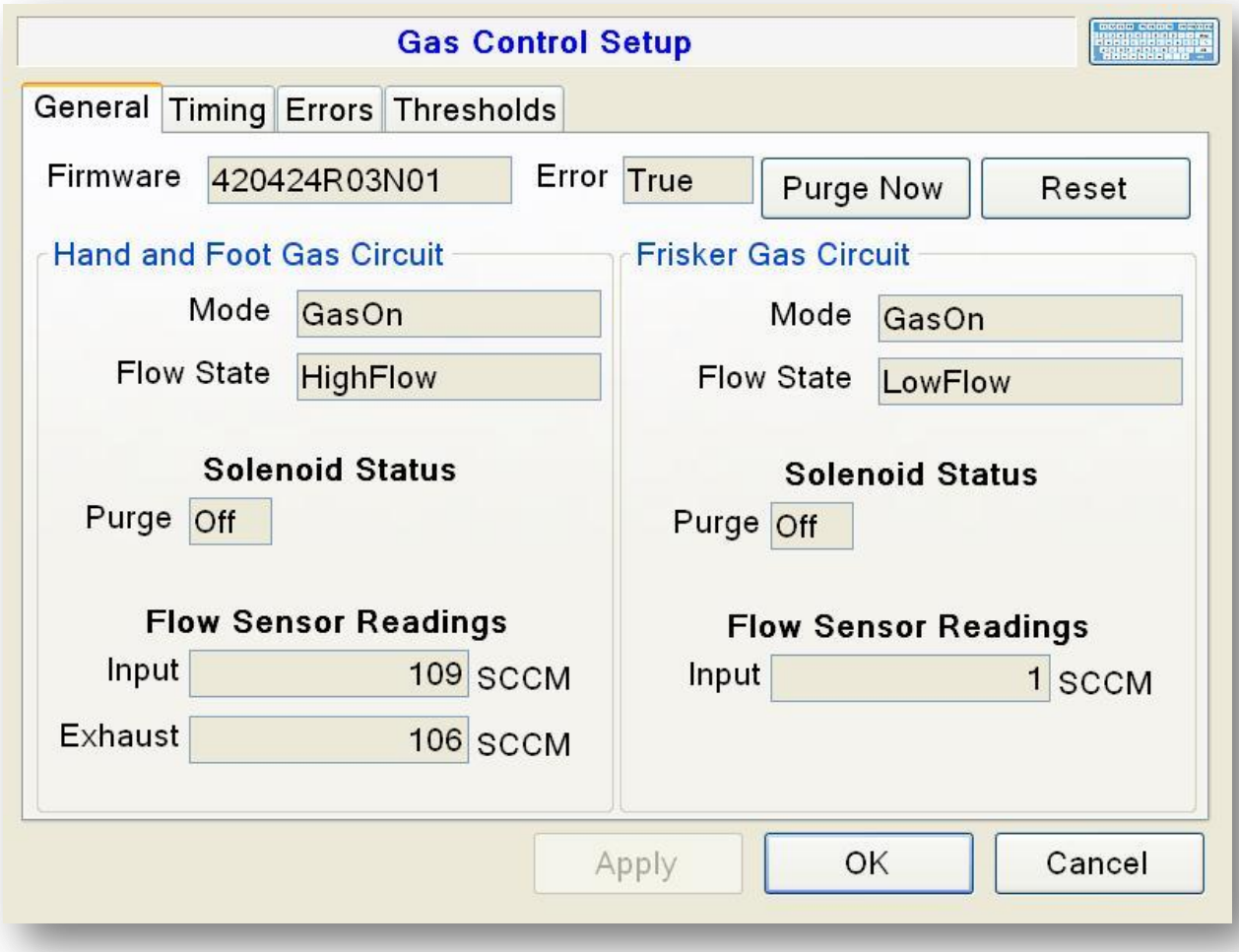
The gas control screen varies based on the version of the gas system. Gas System Version 1 is indicated by a firmware number of 420424R01N01 or 420424R02N01. This version of the system uses separate hand, foot, and gas circuits with solenoid valves at the input of each circuit. The fundamental operation of the system is to purge on power-up, then continuously run a cycle of gas on, gas off, gas on…by switching the solenoids on and off. This system has no electronic sensor for gas flow when using gas proportional friskers. When a Version 1 gas system equipped Model 4906 is turned off, the solenoids shut and no gas will flow; however, an external shutoff is recommended.

Gas System Version 2 is indicated by a firmware number of 420424R03N01 or greater. This version of the system uses a single primary gas flow circuit for both the hands and feet. There is a separate circuit for an equipped gas proportional frisker. The fundamental operation of a Version 2 system is for the system to purge quickly using supply gas pressure and flow. This is accomplished by using the solenoids to switch open a bypass of the normal throttle valves. This allows much quicker purge times (generally 45-90 minutes) than the previous system. Once the purge is done, the solenoids switch off and the gas-on state is maintained with a continuous steady state gas flow rate based on the primary and frisker throttle valve settings. This allows the quicker purge time to be coupled with lower steady state (operational) gas consumption. When a Version 2 gas system equipped Model 4906 is turned off, the steady state gas flow remains on unless the gas supply to the unit is stopped by an external shutoff.

Gas System Version 3 is indicated by a firmware number of 420424R03N04 and greatly simplifies the gas controller operation. In this version, the gas controller reports the flow readings of the three gas sensors and the status of the solenoids. The Supervisor handles the gas purge timing. It is also possible to adjust the I2C address of the flow sensors. The screen shots shown are for Version 3.

General


Gas Control Setup
General
Timing
Thresholds
Firmware
420424R03N04
Purge Now
Hand and Foot Gas Circuit
Mode
GasOn
Flow State
Functional
Solenoid Status
Purge
Off
Flow Sensor Readings
Input
60
SCCM
Exhaust
60
SCCM
Refresh
Apply
OK
Cancel



The General tab on the Gas Control screen provides the most detailed information on the current state of the gas flow controller and system gas flow.

The Firmware number of the gas control board is displayed in the top left corner and acquired through communication via the host board.

The Purge Now button will immediately begin a gas system purge when clicked. For Version 1 gas systems, this is a long gas-on time at normal flow rates. For a version 2 gas system, this is a long gas-on time at supply pressure and flow rates (flow restriction orifices allow the detector faces to withstand supply pressures up to 15 psi). For Version 3, the gas purge time is controlled by the Supervisor. Once this purge is complete, the system returns to the standard cycle as determined by Timing values. For Version 1 systems, this is an ON -> OFF -> ON cycle. For Version 2 and 3 systems, this is a steady continuous gas on cycle.

The Reset button forces a gas controller reset. Once reset is complete, the controller will automatically enter the gas purge state followed by the standard cycle for the gas system version installed in the unit.

The Error indication box displays True if the gas controller is reporting a general error and False if not. A General error is simply an indication of some sort of problem from communication to sensor readings that indicate potential flow error conditions. More detailed information can be determined using the individual circuit data and Timing, Error, and Threshold values.

The circuit information groups show detailed information regarding the status of each gas circuit. For Version 1 systems, these are the Hand group and the Foot group. For Version 2 systems, these are the Hand and Foot group and the Frisker group if equipped. Version 3 is identical to Version 2.

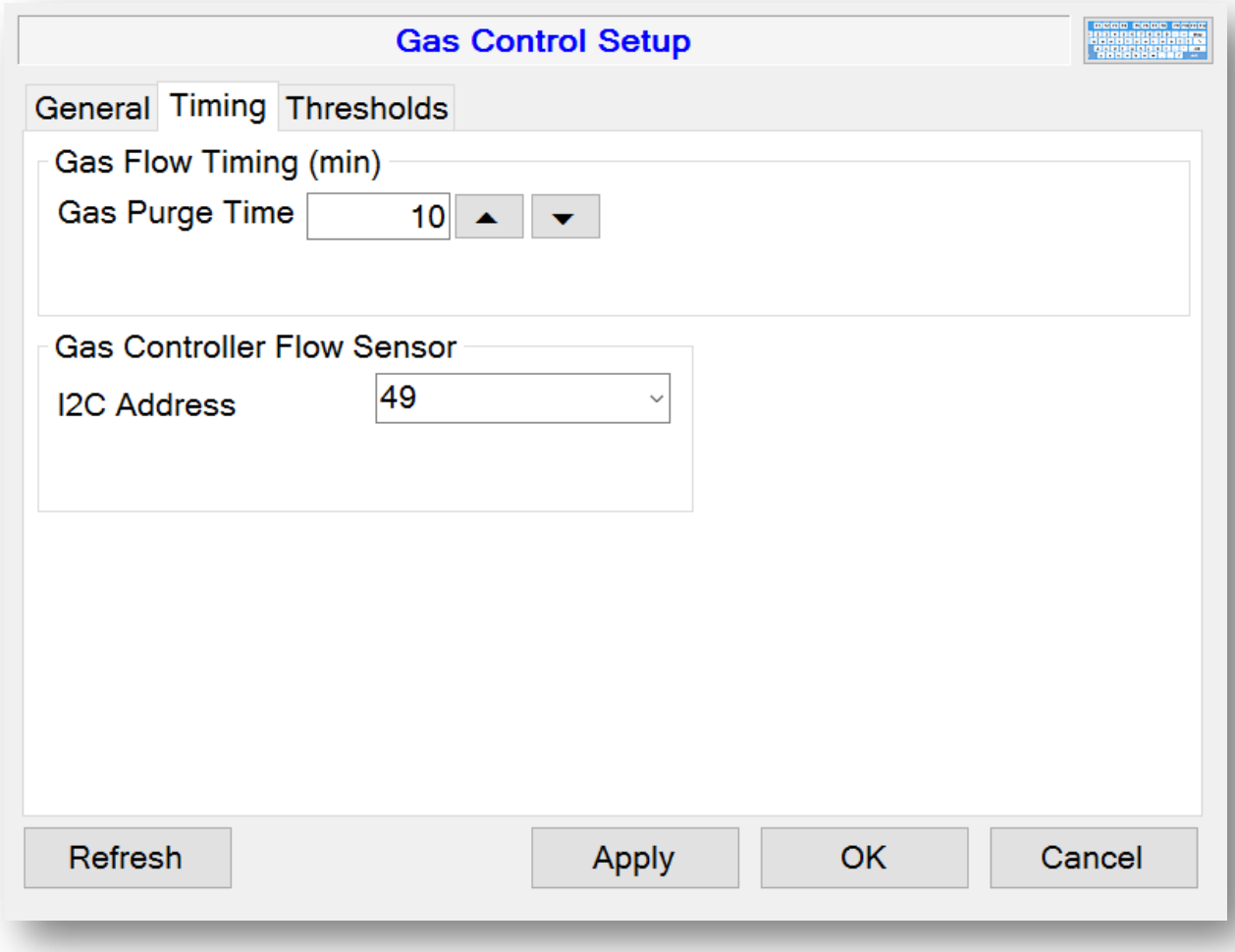
The Mode box displays the current gas circuit mode of operation, either GasOn, GasOff, or GasPurge.

The Flow State box displays the current flow state, either Invalid (gas controller or communication problem), Functional (gas circuit operating properly), GasLeak (gas leak error), SolFailOpen (solenoid failed open), SolFailClose (solenoid failed closed), AddGasSrc (additional gas source error), and HighFlow (high gas flow rate error).

The Solenoid Status indictor boxes display the state of the Input and Exhaust solenoid circuits on Version 1 gas systems. On Version 2 gas systems these boxes display the status of the Purge solenoids. ON indicates the solenoid output circuit is turned ON and any solenoid connected to that circuit should be in the flowing or open state. OFF indicates the solenoid output circuit is turned OFF and any solenoid connected to that circuit should be in the no-flow or closed state. Not all gas system Version 1 4906 units are equipped with exhaust solenoids, but the exhaust solenoid circuit status will always be displayed.

The Flow Sensor Readings boxes display the Input and Exhaust flow sensor readings. These readings are updated once every five seconds to reflect the latest reading information.

Timing



The Timing tab facilitates adjustment of the gas flow cycle timing, as well as sensor sampling rate and delay timing used during state transitions to determine when to start looking for error conditions. For Gas version 3 there is only a setting for the purge time and the I2C address for the flow sensor. This address should not be changed unless a new flow sensor board is installed.

The Gas Flow Timing group allows setup of the basic gas cycle timing values. Once the gas controller is powered on, it will immediately command a gas purge of the length set in the Gas Purge Time box to ensure the system is full of gas. Additionally, a purge can be triggered by the Purge Now button. For Version 1 gas systems, once the purge is complete, the system transitions from the purge state to the gas-off state. This begins the normal cycle in which the system

switches between the ON and OFF states at intervals determined by the Gas On Time and Gas Off Time. If either the Gas On Time or Gas Off Time is set to 0, the gas system will remain in that state indefinitely. For Version 2 gas systems, a purge is immediately followed by a transition to the gas-on state that last until another purge is commanded or gas flow is cut off by an external shutoff valve.

The Interval Timing group allows setting of the Sensor Read Interval and Flow Error Delay. The Sensor Read Interval is the time between each flow sensor reading. This value defaults to 1 second and generally should be left at the factory set point. The flow Error Delay value sets the amount of time after a flow state change (from Gas Purge to Gas On, for example) before error conditions are analyzed. This delay gives the gas system time to stabilize and avoid triggering of errors due to normal state transitions.

Errors

The Gas Control Errors tab is used to set the number of times an error condition must occur before an error state is triggered. If the number beside the Gas Leak Error is 30, then the flow sensor readings on a gas circuit exhaust must be lower than the input by the threshold value for at least 30 successive tests to trigger a Gas Leak Error. This allows for transients that may occur as personnel step on and off of the unit. The Apply, OK, and Cancel buttons function in the same manner as with previous screens. The Errors tab is not available with Gas Version 3.

Gas Flow Error States

The gas flow errors that can occur are listed below with a description of the error meaning:

- Additional Gas Source – If gas flow at the exhaust is greater than gas flow at the input by a threshold value, an additional gas source error is triggered. The error name refers to the readings that indicate flow consistent with an additional gas source being added in the system between the input and exhaust sensors.

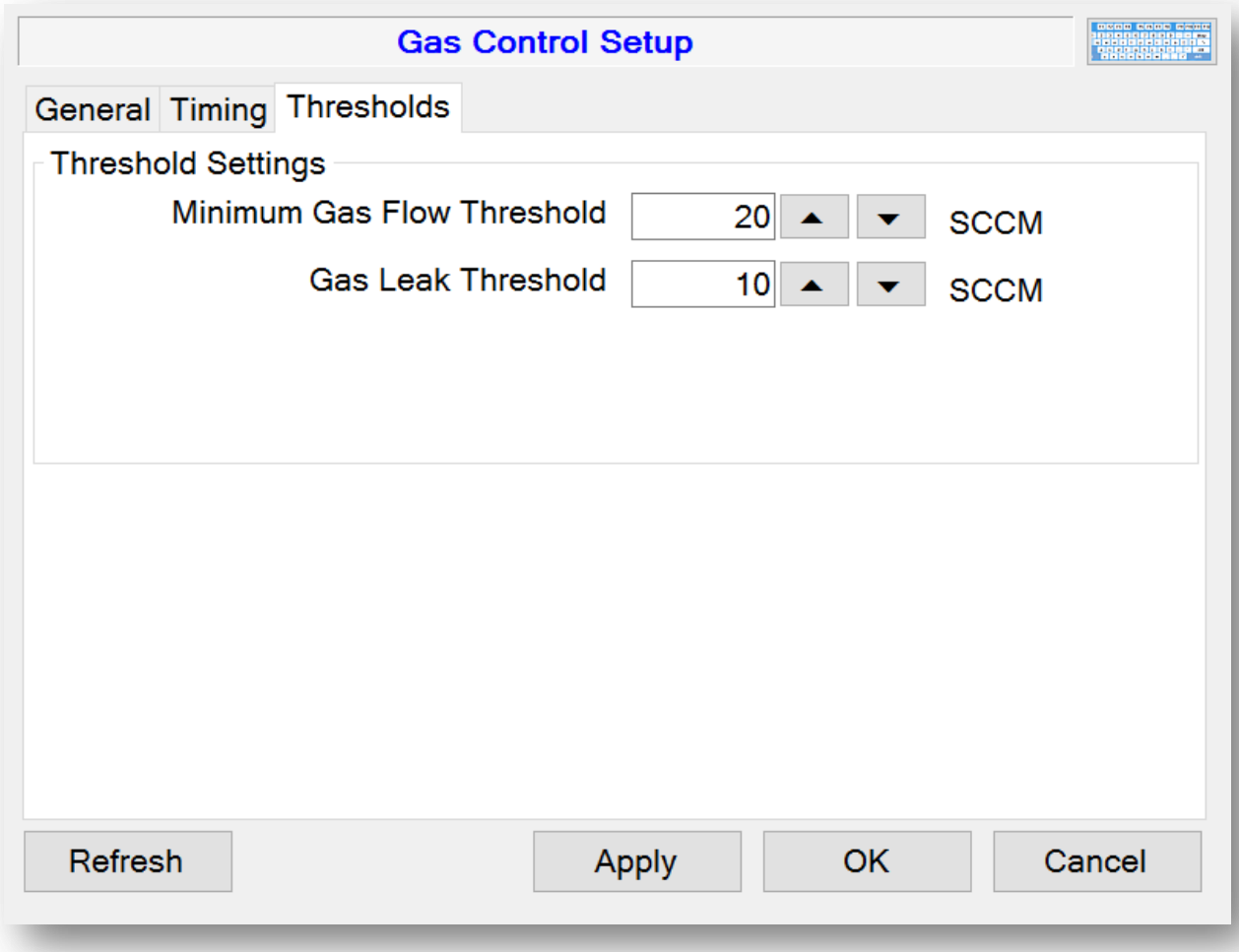
- Gas Leak – If gas flow at the input is greater than gas flow at the exhaust by a threshold value, a gas leak error is triggered. The error name refers to the readings that indicate flow consistent with a gas leak in the system between the input and exhaust sensors.

- High Gas Flow – If the flow reading on a sensor is above the high gas flow threshold, a high gas flow error is triggered.

- Solenoid Failed Open – If the gas controller has commanded the solenoids on a circuit closed, but flow continues to not be seen at either sensor, a solenoid failed open error occurs.

- Solenoid Failed Closed – If the gas controller has commanded the solenoids on a circuit open, but flow is not seen at either sensor, a solenoid failed closed error occurs. This error may also be triggered by a lack of gas supply to the Model 4906 HFM when the gas controller is in the gas-on state.

Thresholds



The Threshold tab allows setting of the flow thresholds used to determine when certain error conditions are present.

The Minimum Gas Flow Threshold determines the minimum flow reading required for gas to be considered "flowing." All flow values at or above this reading are considered "flowing," while values below are considered "not flowing." This threshold is used in determination of the solenoid fail open and solenoid fail closed error conditions.

The Gas Leak Threshold sets the difference between the exhaust and input sensor flow rates required for a gas leak error to occur (input – exhaust).

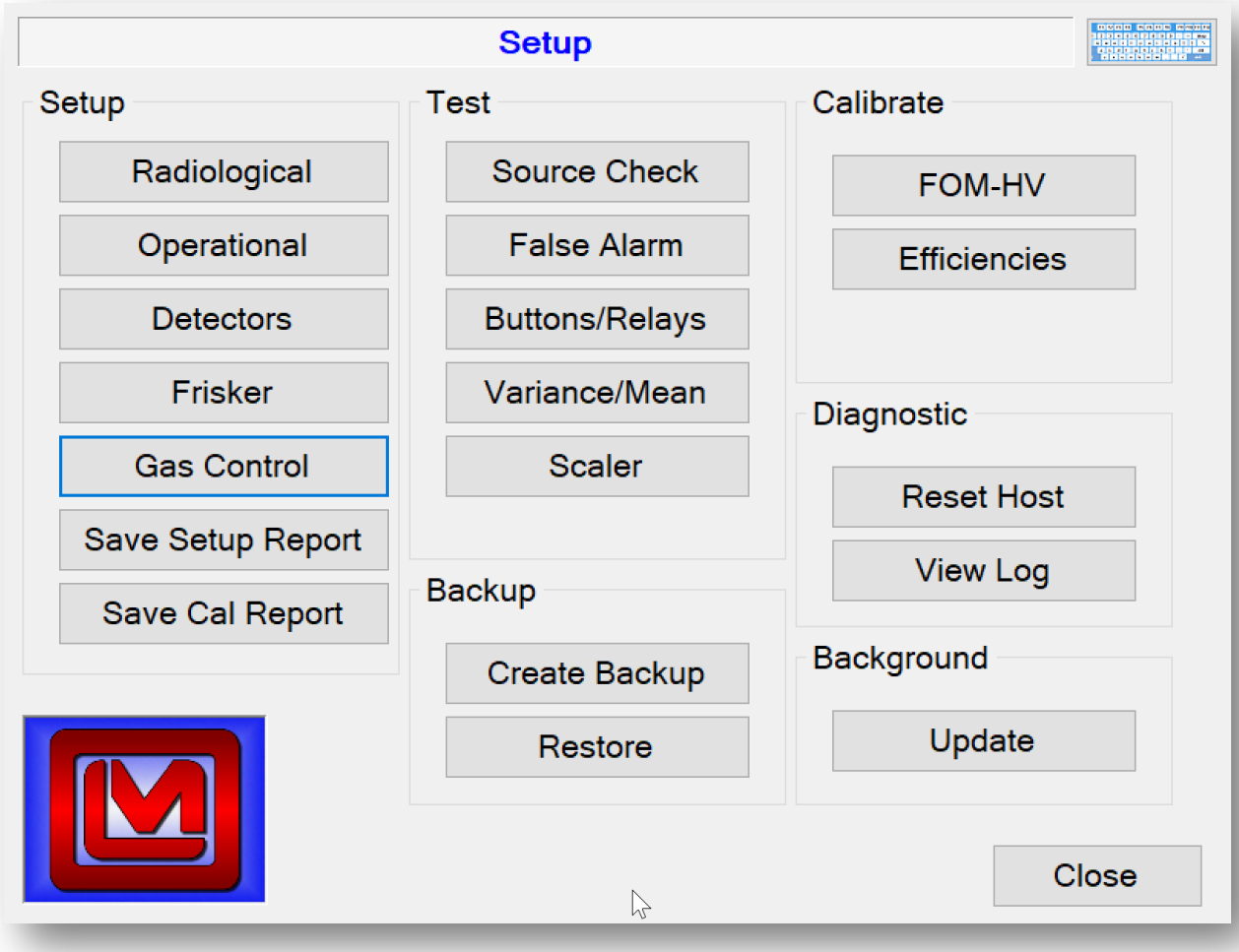
The Additional Gas Source Threshold sets the difference between the exhaust and input sensor flow rates required for an additional gas source error to occur (exhaust – input). Not available for Gas Version 3.

The High Gas Flow Threshold set the maximum flow rate that can be sensed at any one sensor before a high gas flow error occurs. This error is ignored during the purge state as gas flow rates in this state generally reach full scale on the flow sensors. Not available for Gas Version 3.

Section 14

Save Report

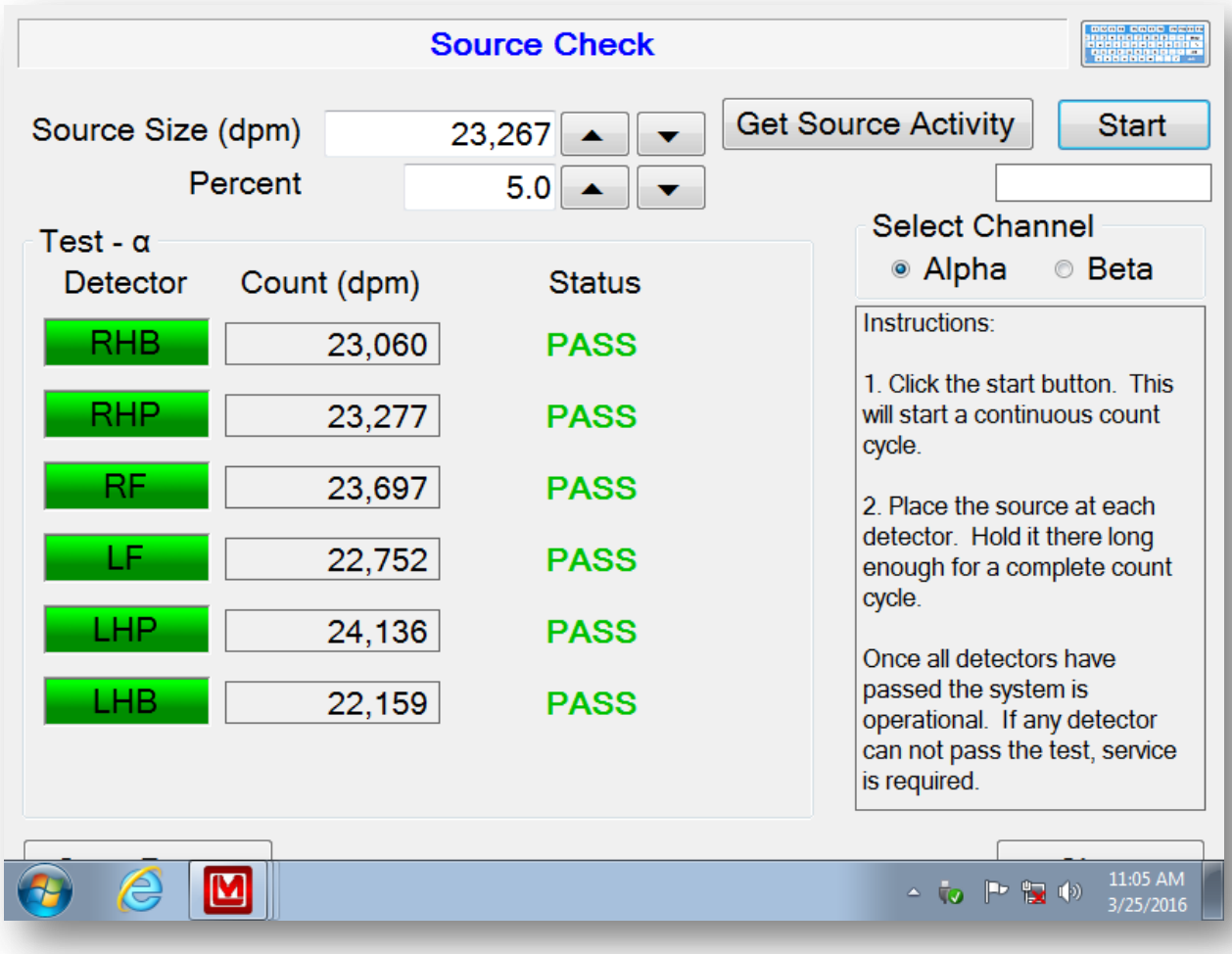
The Save Report button on the Setup Menu screen saves a report file with the current Model 4906 HFM settings. This file is formatted for printing if desired and can be saved with any name and location desired using the standard Windows "Save As" file browser interface.



Section 15

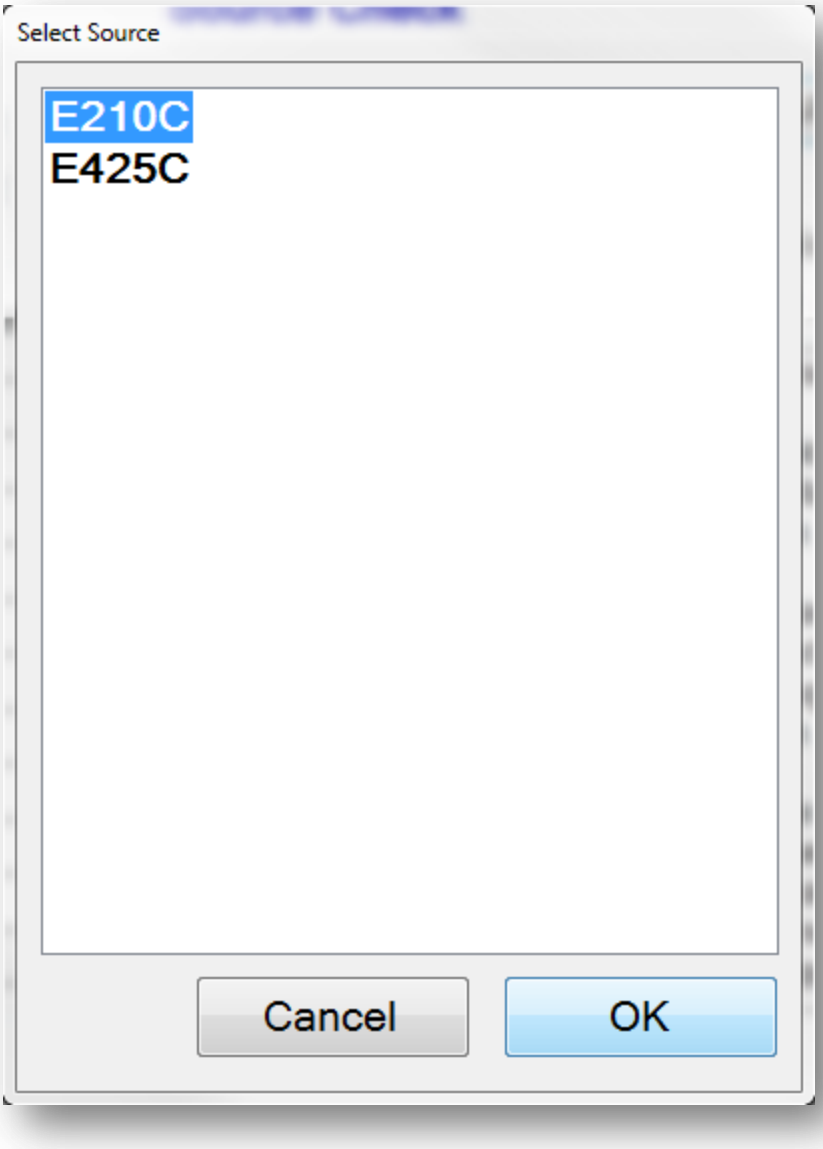
Source Check

The Source Check screen can be used to perform a test on the detectors to verify they are still functioning correctly.



For two channel systems, select the appropriate channel for the source check (alpha or beta). Enter the source size of the check source and a percentage that the counts must fall within to be considered acceptable.

When using a source currently entered into the Model 4906 source library, the current activity of that source can be entered into the Source Size box by clicking the Get Source Activity button. This will open a window allowing selection of any one source from the sources entered into the system. Select a source and click OK to have that source's calculated current activity entered into the Source Size box in dpm.



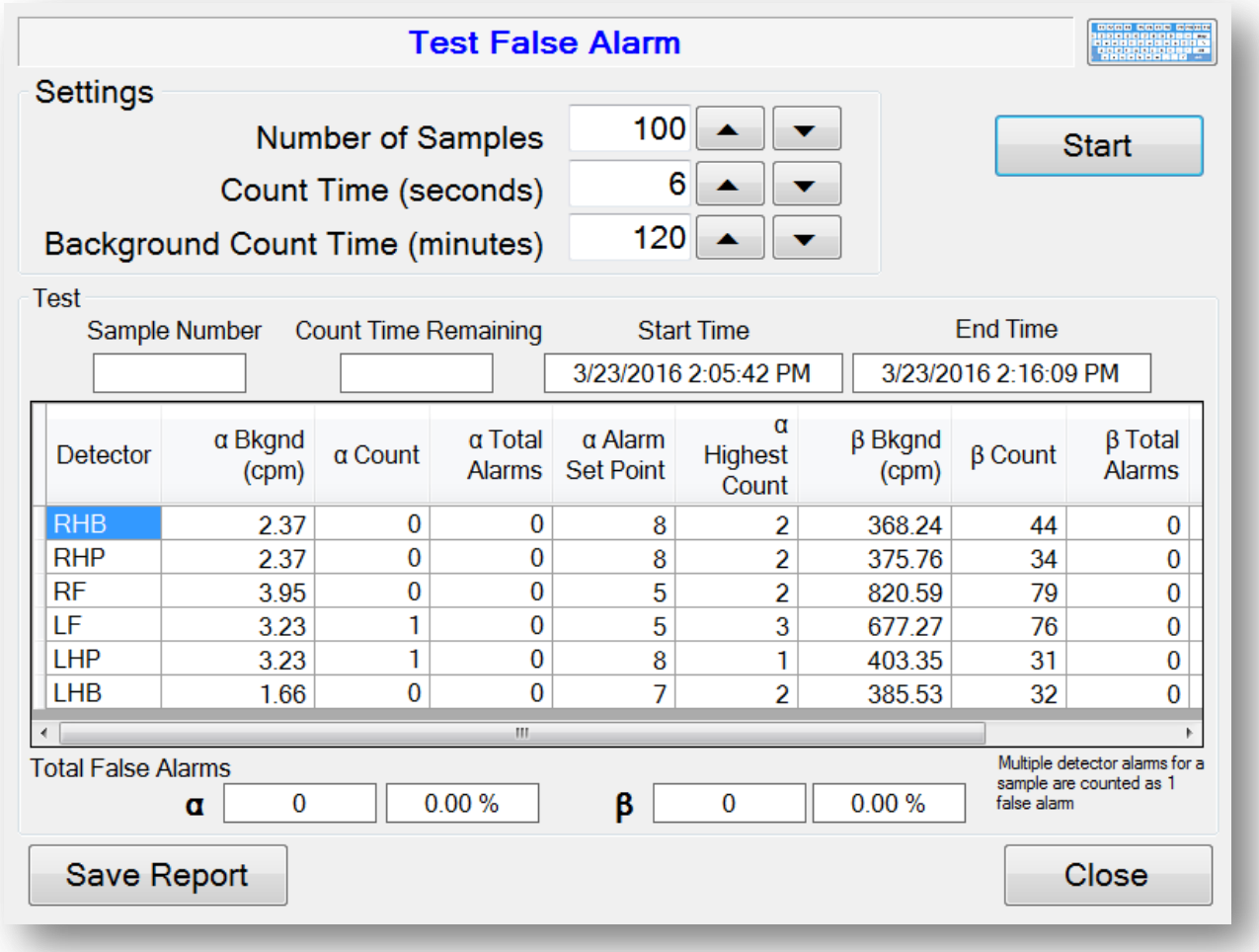
Click the Start button to start the test and position the source next to each detector. The system will run continuous counts using the normal monitoring

count time until all detectors pass or the test is cancelled. Once a source check has been completed, save the test data by clicking the Save Report button.

Section 16

False Alarm

The False Alarm screen is used to run a series of counts to determine the false alarm rate. The number of samples to run, count time, and background count time are user adjustable.



After setting these parameters, click the Start button to begin the false alarm test. The current sample number, count time remaining, end time, and total false alarms are displayed.

Should an alarm be posted, an immediate background update will follow so as to track any potentially changing background average.

During the false alarm test, the current background, raw count, total alarms, alarm set point, and high count are displayed in the grid for each detector. Click the Cancel button to stop the test.

The criterion for an alarm is satisfied when the net (background-subtracted) count rate for any detector exceeds the alarm set point (R_A).

$$R_A = K_B \sqrt{\frac{R_B}{T} + \frac{R_B}{T_B}}$$

Where:
R_A = Alarm set point in cps.

K_B = Background sigma coefficient, which determines the false alarm probability.

R_B = Average background count rate in cps for the detector.

T = Count time in seconds.

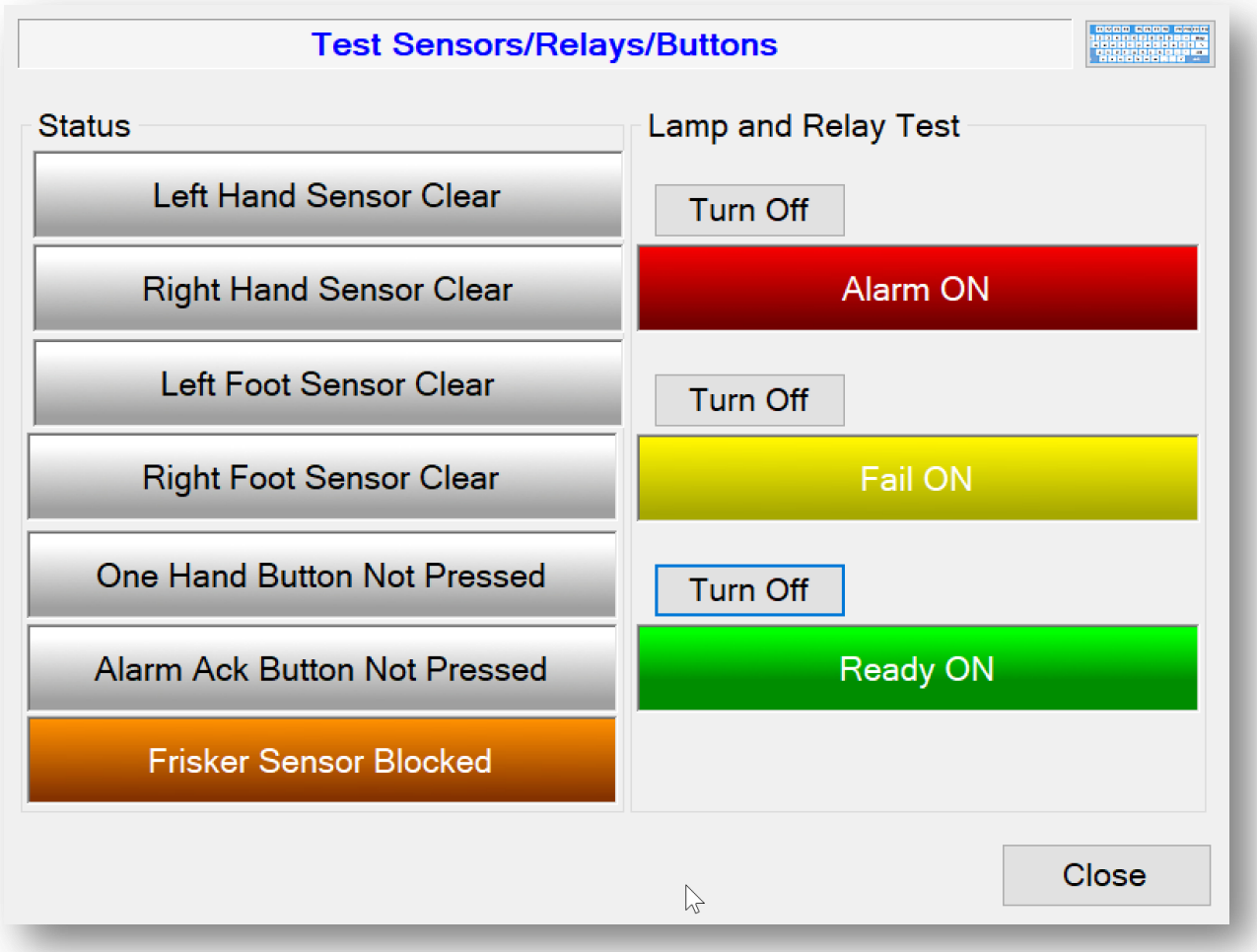
T_B = Background count time in seconds.

Only one false alarm will be reported regardless of how many detectors alarmed.

Section 17

Buttons/Relays

The Buttons/Relays screen is used to test the various inputs and outputs on the Model 4906.



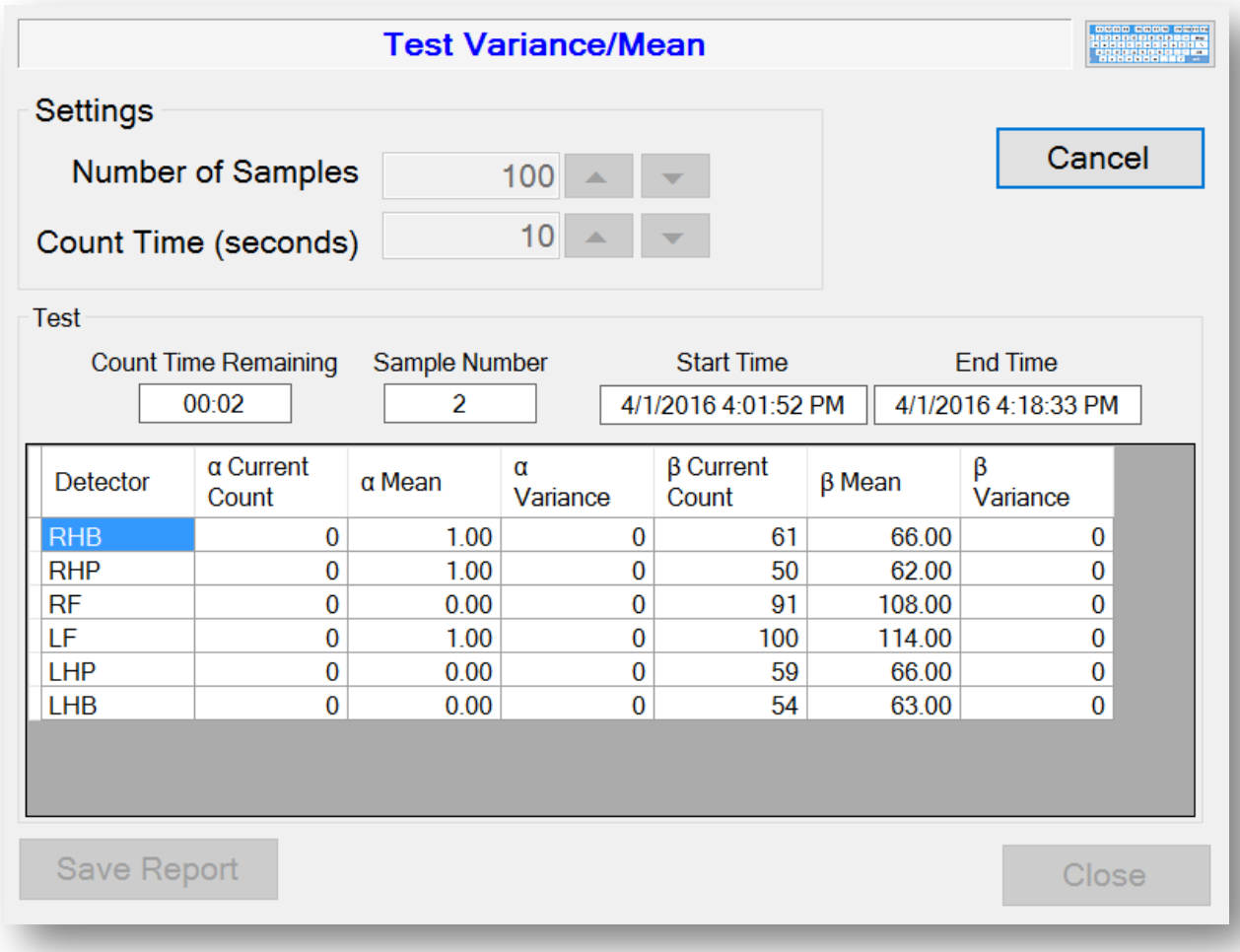
The outputs include the lights in the stack, relays, and infrared sensors. The inputs include the infrared sensors and pushbuttons. Click on the buttons to turn on/off the lights/relays. When a pushbutton is pressed, the indicator should light up to indicate the button was read successfully. The Model 4906

should be taken out of service if any button, sensor, or light fails to respond correctly.

Section 18

Variance/Mean

The Variance/Mean screen is used to determine the stability of the background and should be run once the Model 4906 is set up. The number of samples and count time are user adjustable.



Detector	α Current Count	α Mean	α Variance	β Current Count	β Mean	β Variance
RHB	0	1.00	0	61	66.00	0
RHP	0	1.00	0	50	62.00	0
RF	0	0.00	0	91	108.00	0
LF	0	1.00	0	100	114.00	0
LHP	0	0.00	0	59	66.00	0
LHB	0	0.00	0	54	63.00	0

Click the Start button to begin the test on the selected detector. The current sample number, count time remaining, and end time are displayed along with the detector count, mean, and variance. Click the Cancel button to stop the test.

The algorithm for computing the variance and mean at the end of each sampling period follows:

Initialization at beginning of Variance/Mean Test

```
mean = 0
sampleCounter = 0
m2 = 0
```

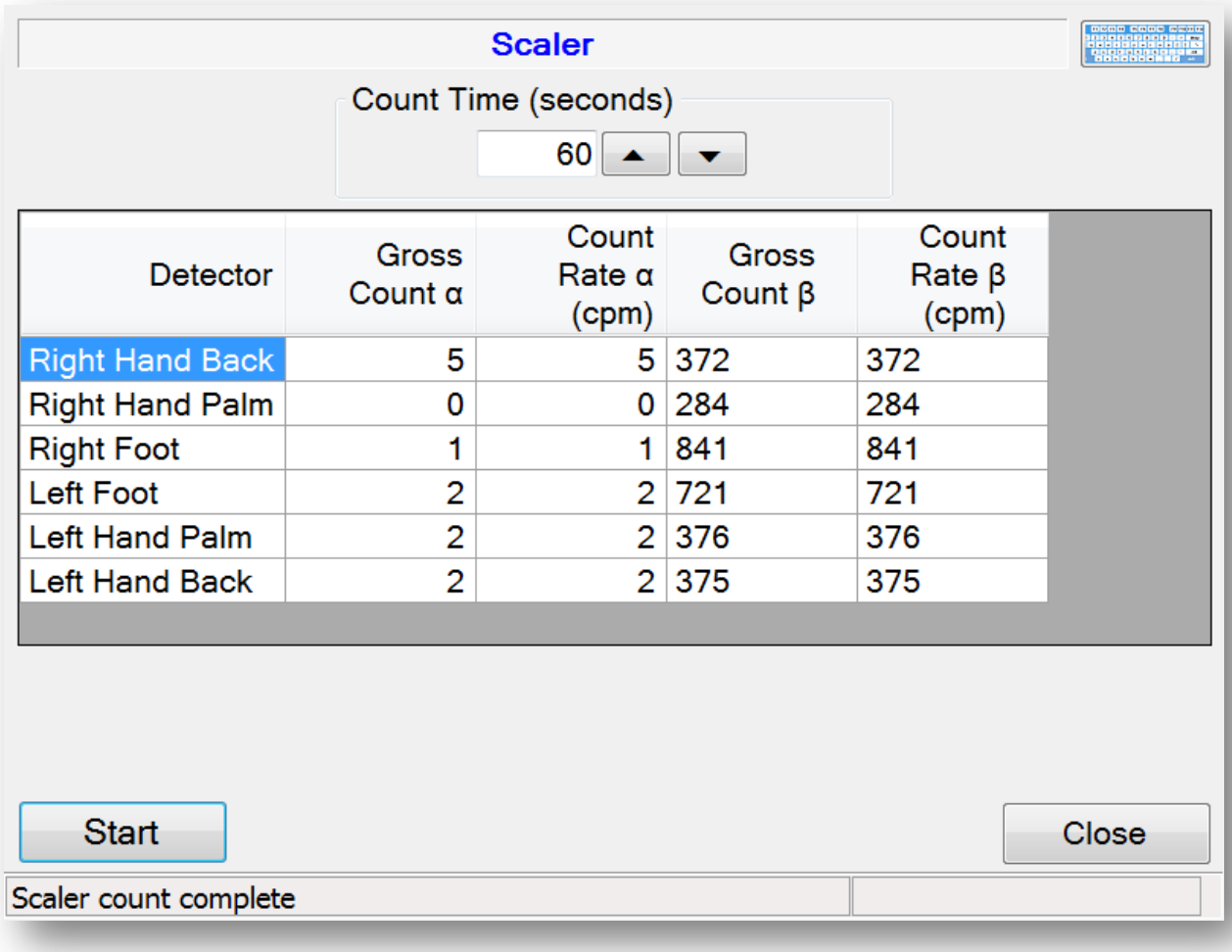
At end of each count.

```
sampleCounter = sampleCounter + 1
delta = count – mean
mean = mean + delta
m2 = m2 + delta * (reading / sampleCounter)
variance = m2 / (sampleCounter -1)
```

Section 19

Scaler

The Scaler screen is used to take timed scaler counts from hand and foot detectors.



Enter a count time value, and then click the Start button. A count of the designated time is then taken in which the gross counts for each channel are

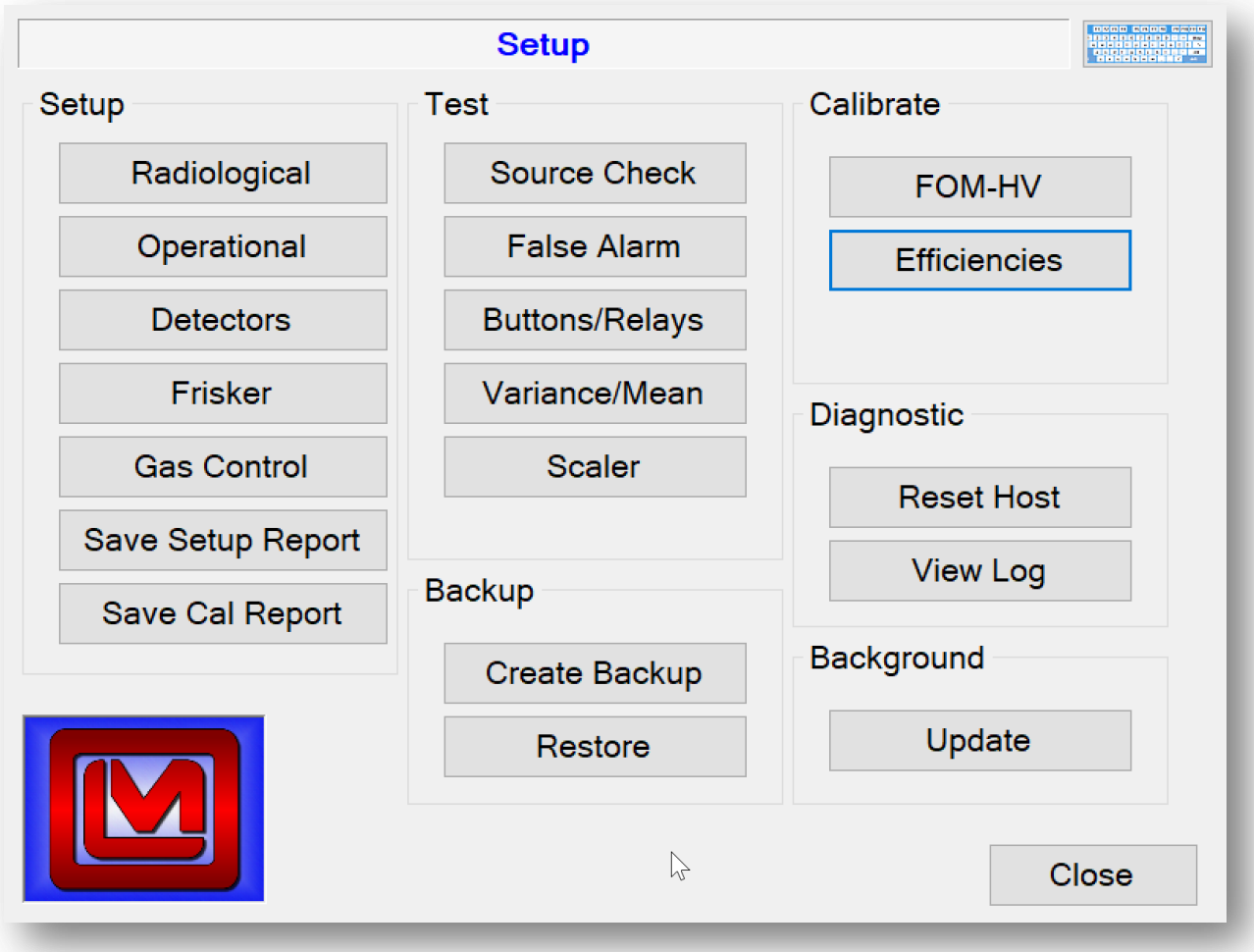
accumulated and displayed in the scaler grid along with calculated count rates for each detector and channel. To take a frisker scaler count ensure the Include Frisker check box is selected before starting a count.

Additionally, if a system failure occurs that requires operator intervention, it can be cleared using the Clear Fail button that appears at the bottom of the Scaler screen.

Section 20

Background Update

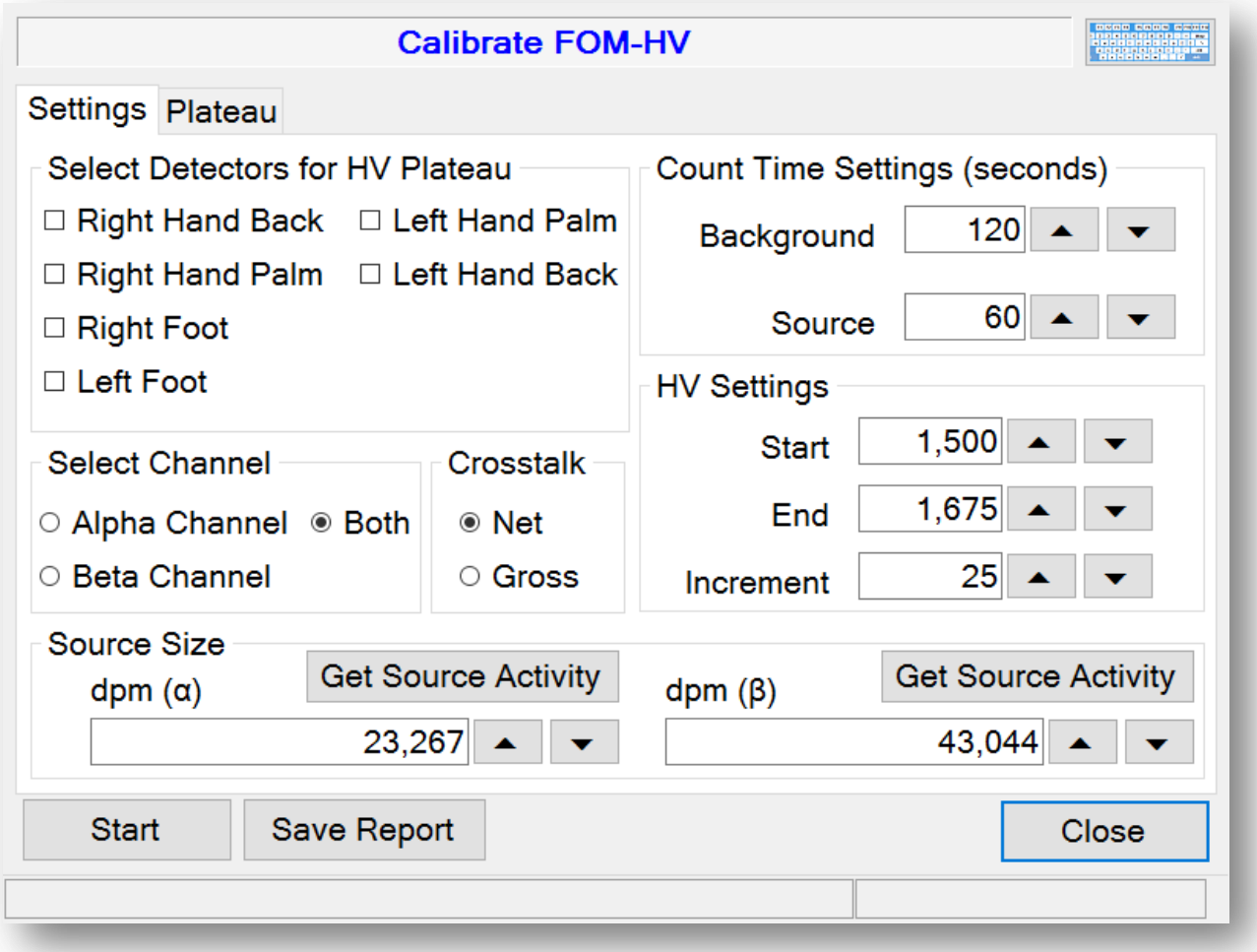
The Background Update button located on the Setup Menu can be pressed to initiate a full background update.



Section 21

FOM-HV

The FOM-HV screen is used to calculate a Figure of Merit to find the optimum high-voltage operating point for each detector. A background count and source count are taken at various high-voltage set points and the best high voltage is chosen. The Settings tab allows selection of which detectors are calibrated, along with the count time for background and source counts.



Select Detectors for HV Plateau

Select which detectors will be included in the calibration. The FOM-HV calibration can be run on multiple detectors or just a single detector.

Select Channel

Select which channel (alpha or beta) to examine when using dual channel systems. For the 4906AB, the default it Both which does both channels at the same time and includes crosstalk data.

Count Time Settings

The background and source count times can be set individually and are adjustable from 1 to 300 seconds.

Source Size

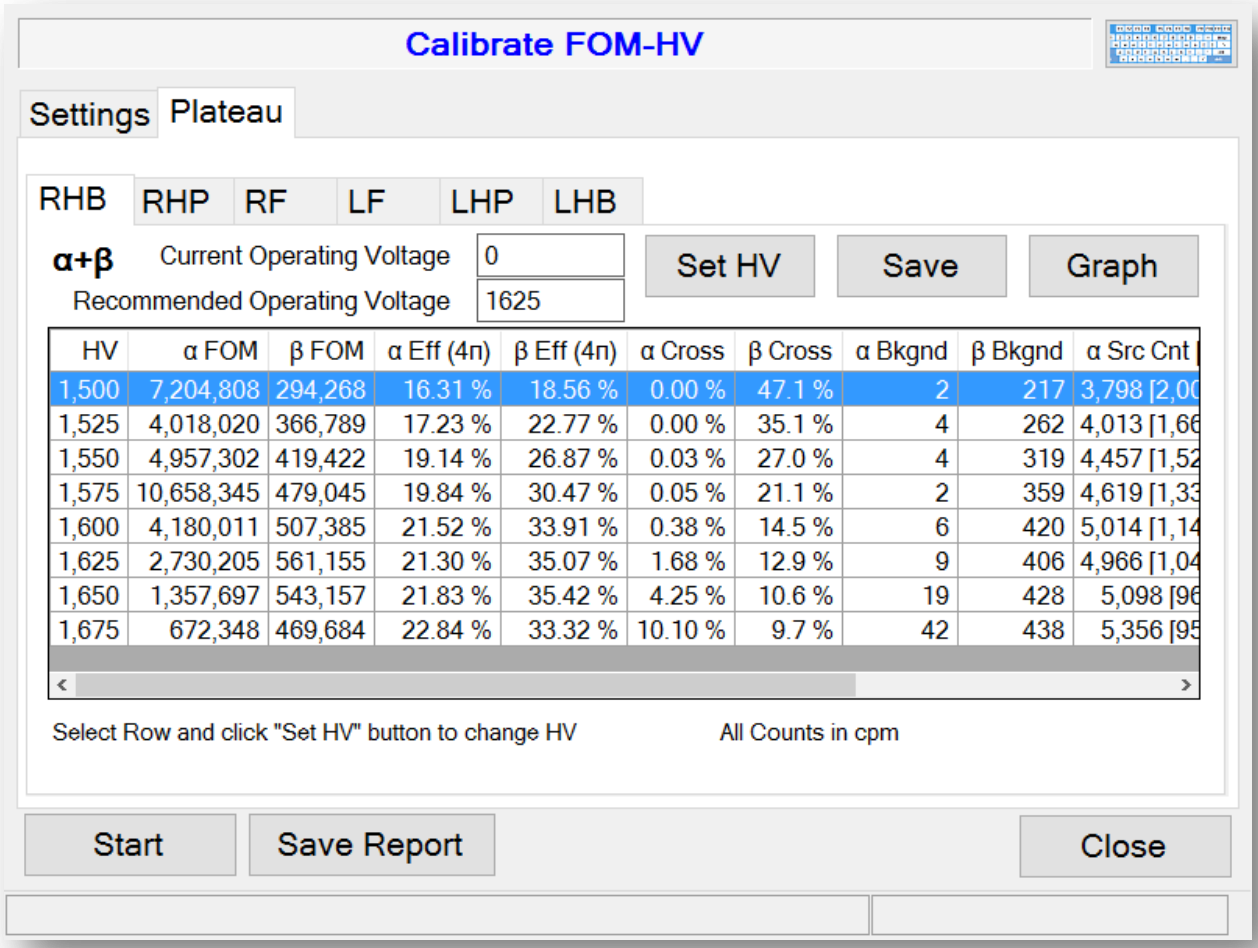
The source size in DPM is used to calculate the detector efficiency. Click the Get Source Activity button to select a source from the source library and have its calculated current activity entered into the Source Size box in dpm.

HV Settings

The start and end of the high-voltage plateau are defined. The default start high voltage is 700 V and the default end high voltage is 1100 V. The high-voltage increment defaults to 25 V and can be adjusted from 1 to 500 V.

Running the FOM-HV

Click the Start button to begin the FOM process. The FOM tab will automatically be selected if necessary. This tab shows a grid that displays the background, source, and net counts, as well as the FOM and efficiency at each high-voltage step.



A prompt will be displayed indicating that all sources should be removed. After acknowledging this prompt, background counts will be taken at each high-voltage step.

When all background counts are complete, a prompt will be displayed indicating that the source must be placed on the specified detector. Click the OK button to start the source count.

The Model 4906 will begin taking source counts at each high-voltage step until completed. Once the current detector is complete, the process will begin for any remaining detectors.

When the FOM is complete, the recommended voltage will be displayed. Select the row of the desired high-voltage setting and click the Set HV button to set the detector's high voltage to the selected set point.

The Figure of Merit is calculated using the following equation:

$$FOM = \frac{S^2}{\left(\sqrt{S} + \sqrt{S+B}\right)^2}$$

Where:

S = Net (background subtracted) source count rate

B = Background count rate

Click the Save Report button to save a FOM report.

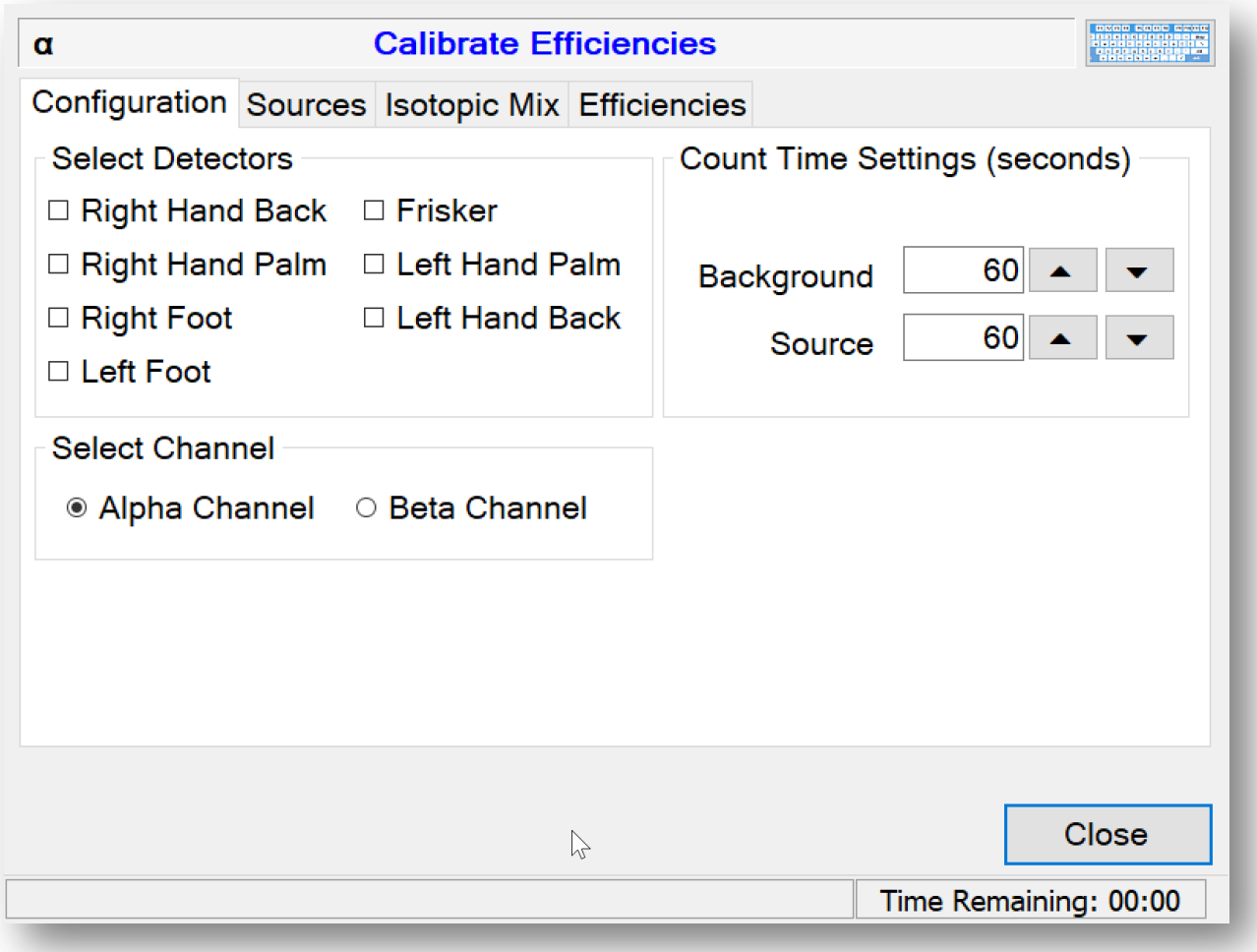
Click the Graph button to display a graph of the three curves. The curves are normalized, i.e., each one peaking at 1, since the scales of the curves can vary dramatically from one another. The background curve is displayed as blue, the net source curve is displayed as red, and the FOM curve is displayed as green.

Section 22

Efficiency

The Efficiency screen is used to manage the isotope and source libraries, set the isotopic mix percentages and enter or gather efficiency data for detectors from various sources.

Configuration

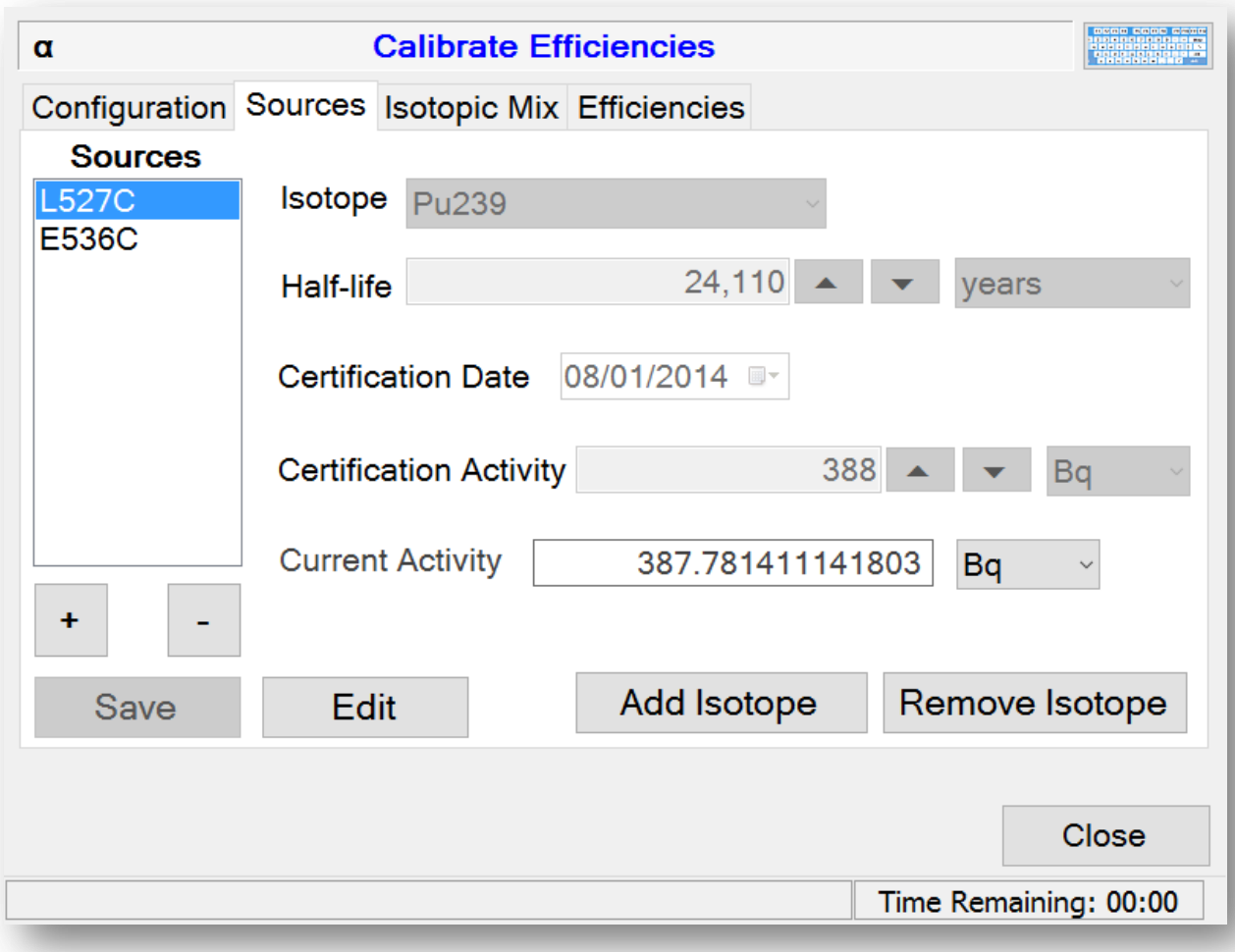


The Configuration tab Allows selection of detectors with which an efficiency test will be run. Select the boxes of all desired detectors before running an efficiency determination.

Setting the count time for the Background and Source count portions of the efficiency determination can be done with the Count Time Settings.

For multiple channel systems, select the appropriate channel for the efficiency determination.

Sources

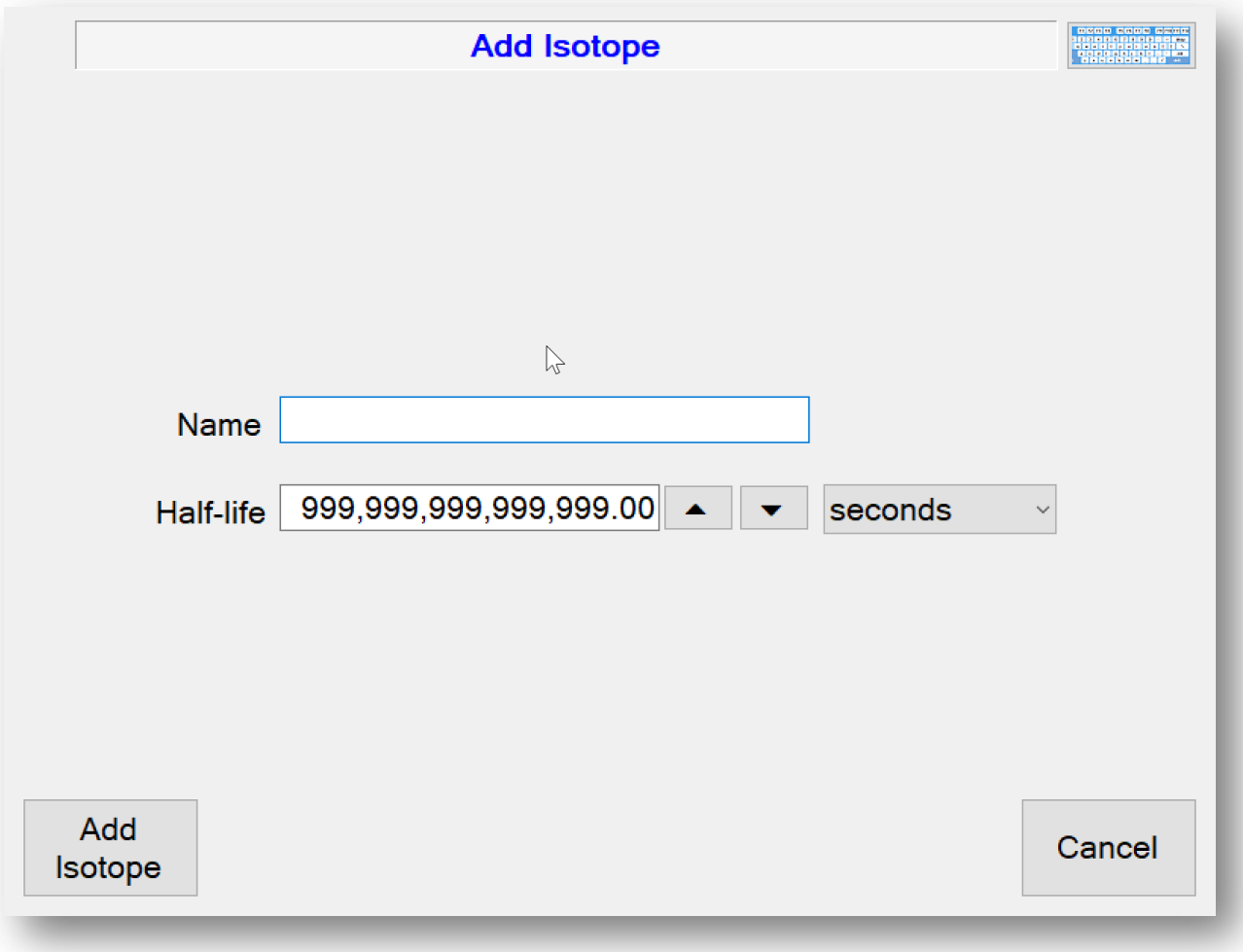


The Sources tab is used to manage the source and isotope libraries. From this tab, isotopes and sources can be added, edited, or removed.

Isotope Library

A list of all isotopes currently available in the isotope library is available in the drop-down box at the top of the tab labeled Isotope. To remove an isotope, select it from the drop down list and click the "-" button next to the Isotope drop-down box. If an isotope is removed that is referenced by sources in the source library these sources will also be removed.

To add an isotope, click the Add Isotope button next to the isotope drop-down box. This will display the Add Isotope screen.



Type in the desired name of the new isotope in the Name box. Then select the desired units for expressing half-life (no decimal numbers can be entered). Next enter the half-life of the isotope. Click the Add Isotope button to close the window and add the new isotope to the isotope library. Click the Cancel button

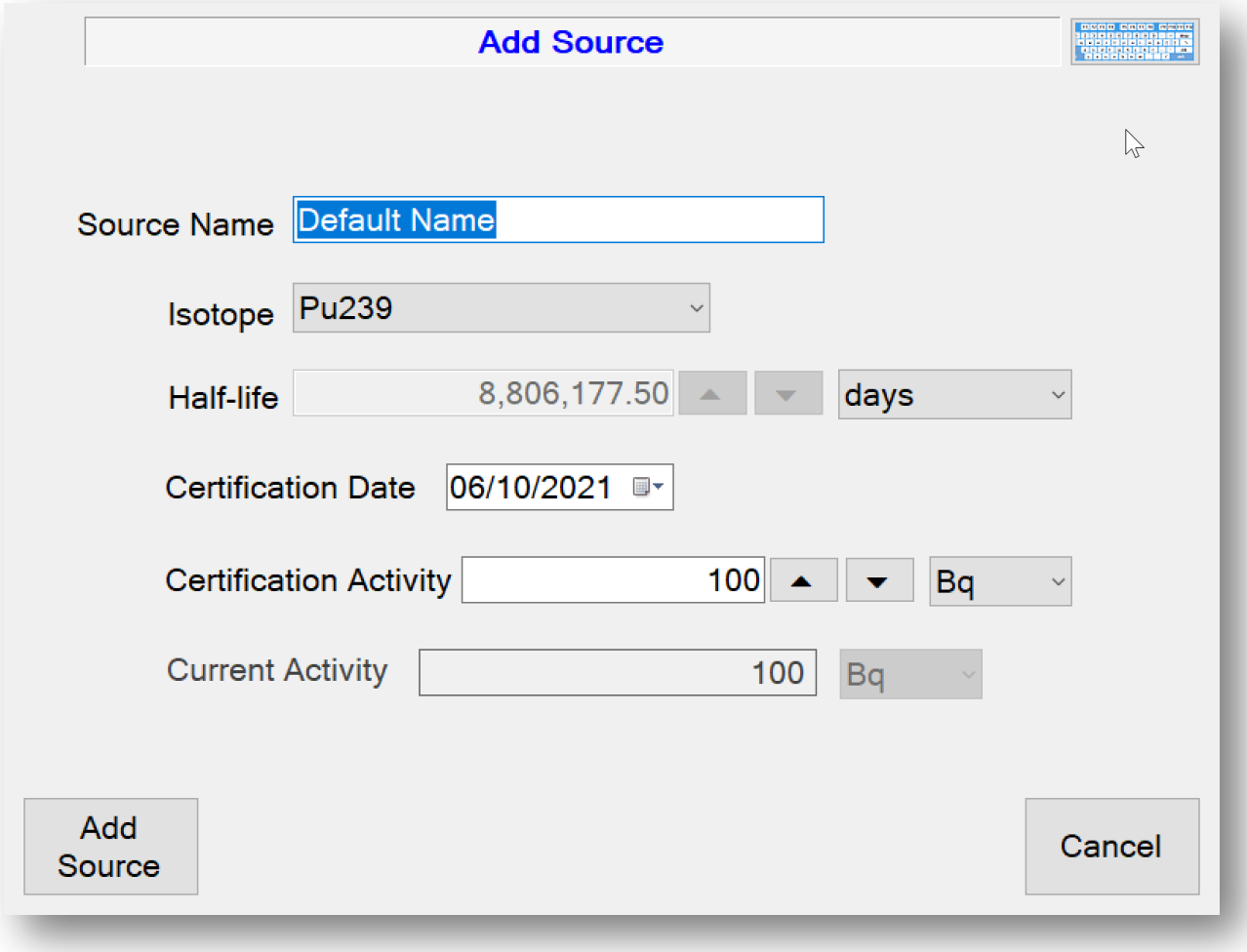
to close the window without adding the new isotope. Once added, the new isotope should be available in the Isotope box on the Sources tab.

Additionally, the Isotope half-life and half-life units can be edited from the Sources tab. Once the half-life is edited, the Save button to the right of the Isotope box is enabled. Click this button to save changes to the isotope library.

Source Library

A list of all sources currently available in the source library is available in the Sources list box on the left-hand side of the Sources tab. To remove a source, select it from the list and click the "-" button below the Sources list box.

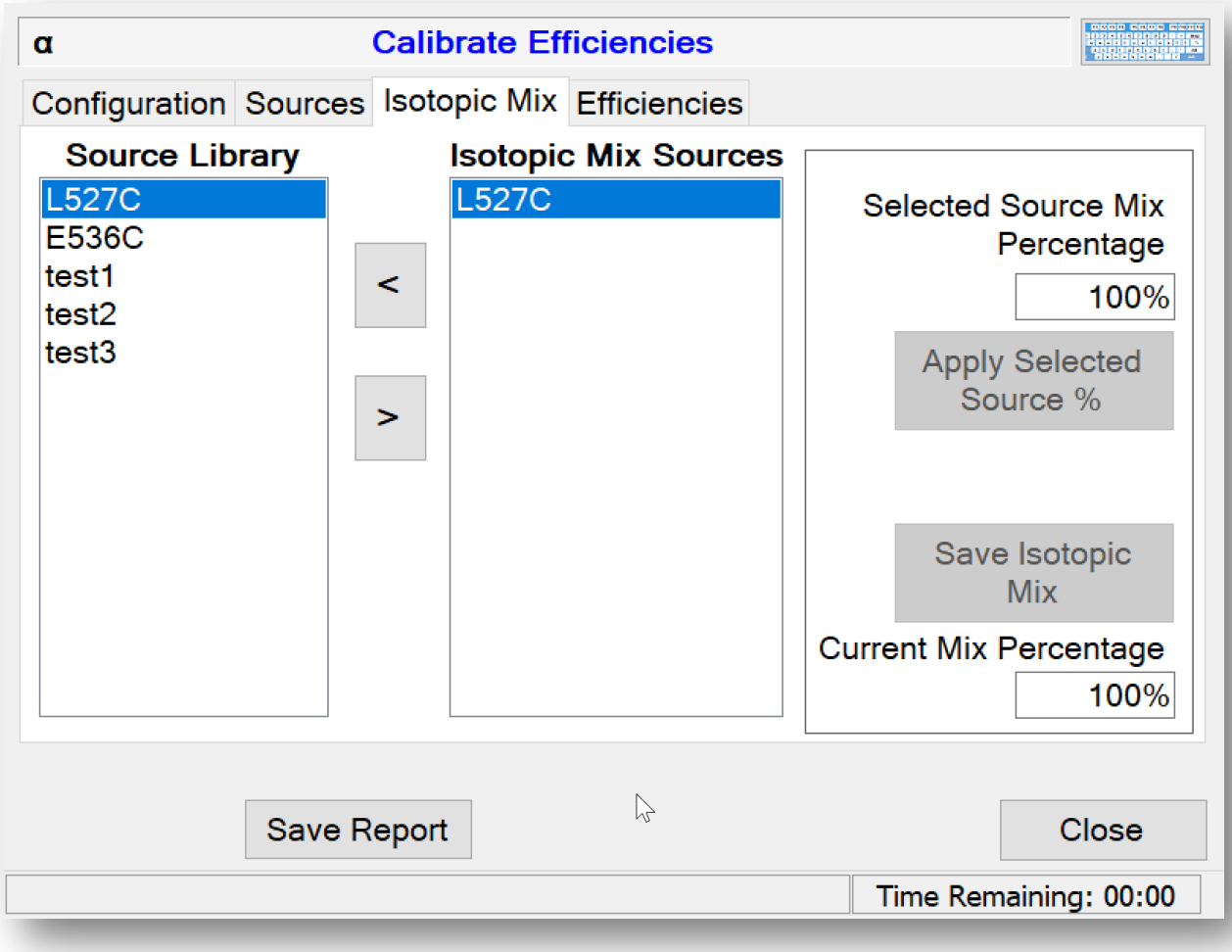
To add a source, click the "+" button located below the Sources list box. This will open the Add Source screen.



Type in the desired name of the new source in the Name box. Then select the desired units, for expressing half-life (no decimal numbers can be entered). Next select the correct source isotope from the Isotope drop-down list. Once an isotope is selected, the half-life will automatically be displayed. To display in different units, change the time units value in the drop-down box next to the half-life box. Then enter the certification date in MM/DD/YYYY format in the Certification Date box. Next select the certification activity units and enter the certification activity in the Certification Activity box. The current activity will be automatically calculated and displayed in the Current Activity box. Once all data entry is complete, click the Add Source button to add the new source to the source library or Cancel to exit without adding the new source.

Additionally, the Source screen can be used to edit any source already in the source library. Select the source to edit from the Sources list. The data for this source is then displayed in the fields to the right of the Sources list on the Sources tab. Edit the values as desired. Once an edit has been performed, the Save button below the Sources list is enabled. After source editing is complete, click the Save button to save changes to the source library.

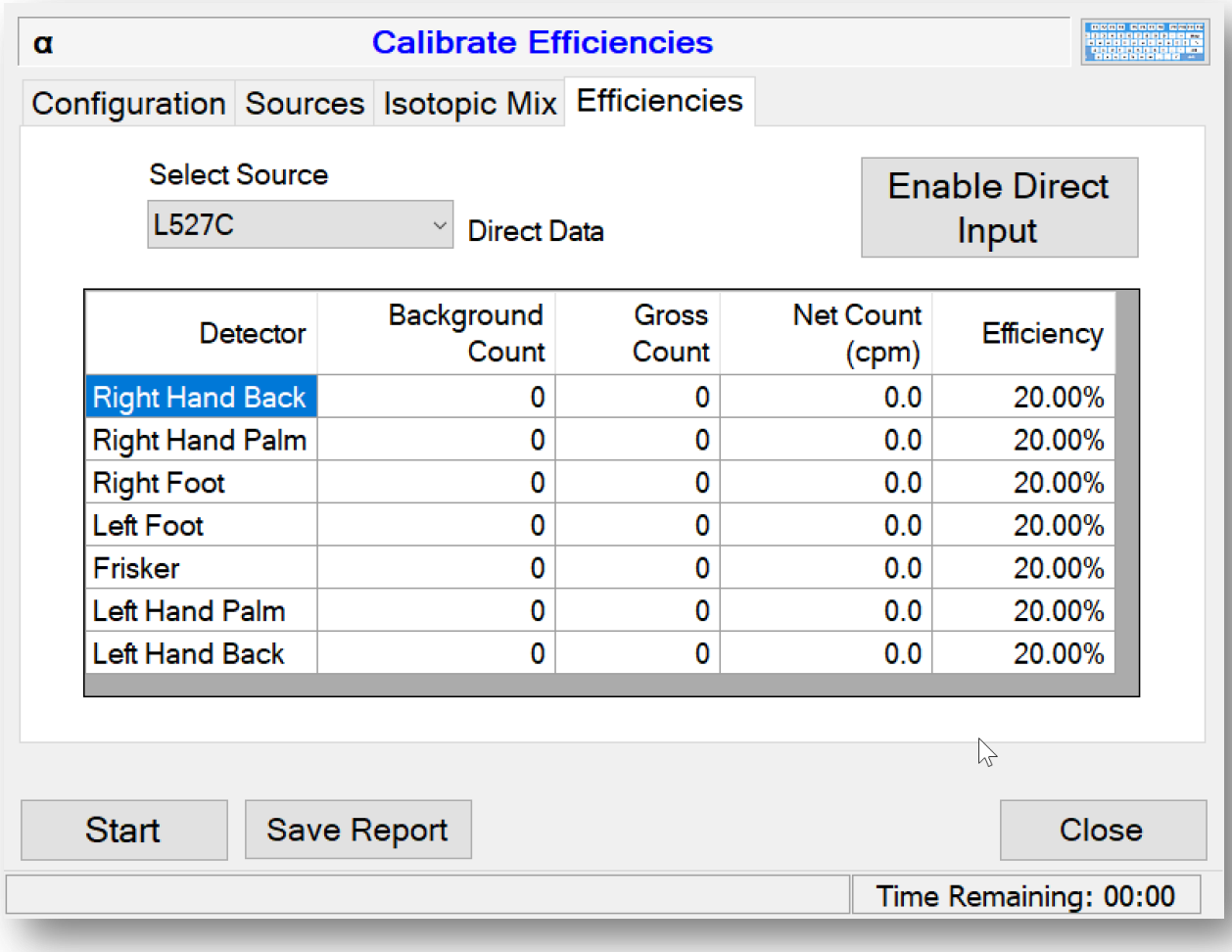
Isotopic Mix



The Isotopic Mix tab allows the setting of the isotopic mix percentages to use for each channel. This informs the system what efficiencies (or combinations or efficiencies) to use when determining alarm set points, count times, and alarm probabilities. Use to arrow buttons to moved desired Isotopic Mix Sources into the Isotopic Mix Sources box from the Source Library and vice versa. Then select each source in the Isotopic Mix Sources box to view its mix percentage in the Selected Source Mix Percentage box on the right. Edit the mix percentage as desired and click the "Apply Selected Source %" button to save the entered value. The Current Mix Percentage box shows the sum of all current isotopic mix sources. This value must add up to 100%.

Click the Save Report button to save a full efficiency and isotopic mix percentage report in a printable format.

Efficiencies



The Efficiencies tab allows determination of source efficiencies via testing or direct data input. Ensure the desired channel is selected on multiple channel systems. Select the desired source for data entry or efficiency determination from the Select Source drop-down list box. Once a source is selected, the text to the right of the Select Source box indicates if the data displayed is "Direct Data" (input by the user directly), "Collected Data" (determined via testing), or "Mixed Direct and Collected Data" (some of both).

To directly input data once the desired source and channel have been selected click the Enable Direct Input button in the top right corner. Then click the cell of the efficiency value to edit and use the keyboard to enter a new value. Once all desired direct values have been entered, click the Save button (the Start button becomes the Save button when direct input is enabled) to save the entered data.

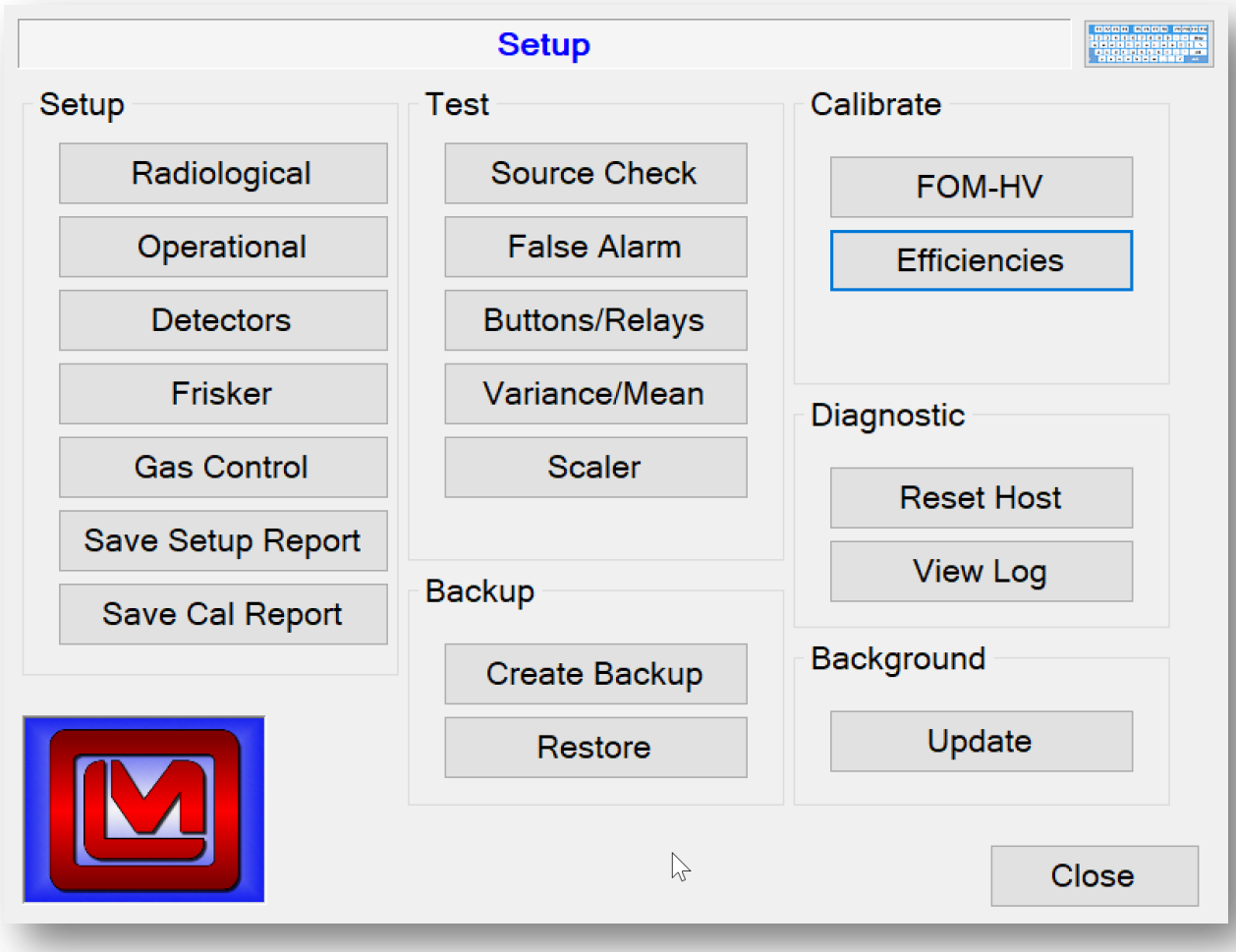
To collect efficiency data via testing, once the desired channel and source are selected and testing parameters have been entered, click the Start button. Follow the on-screen prompts to complete the efficiency determination test.

Section

23

Reset Host

The Reset Host button resets the Model 4906 HFM host board that communicates directly with the internal SBC. This button can be used to attempt a host reset at any time from the Setup Menu. This also cycles power to the detector/gas boards.

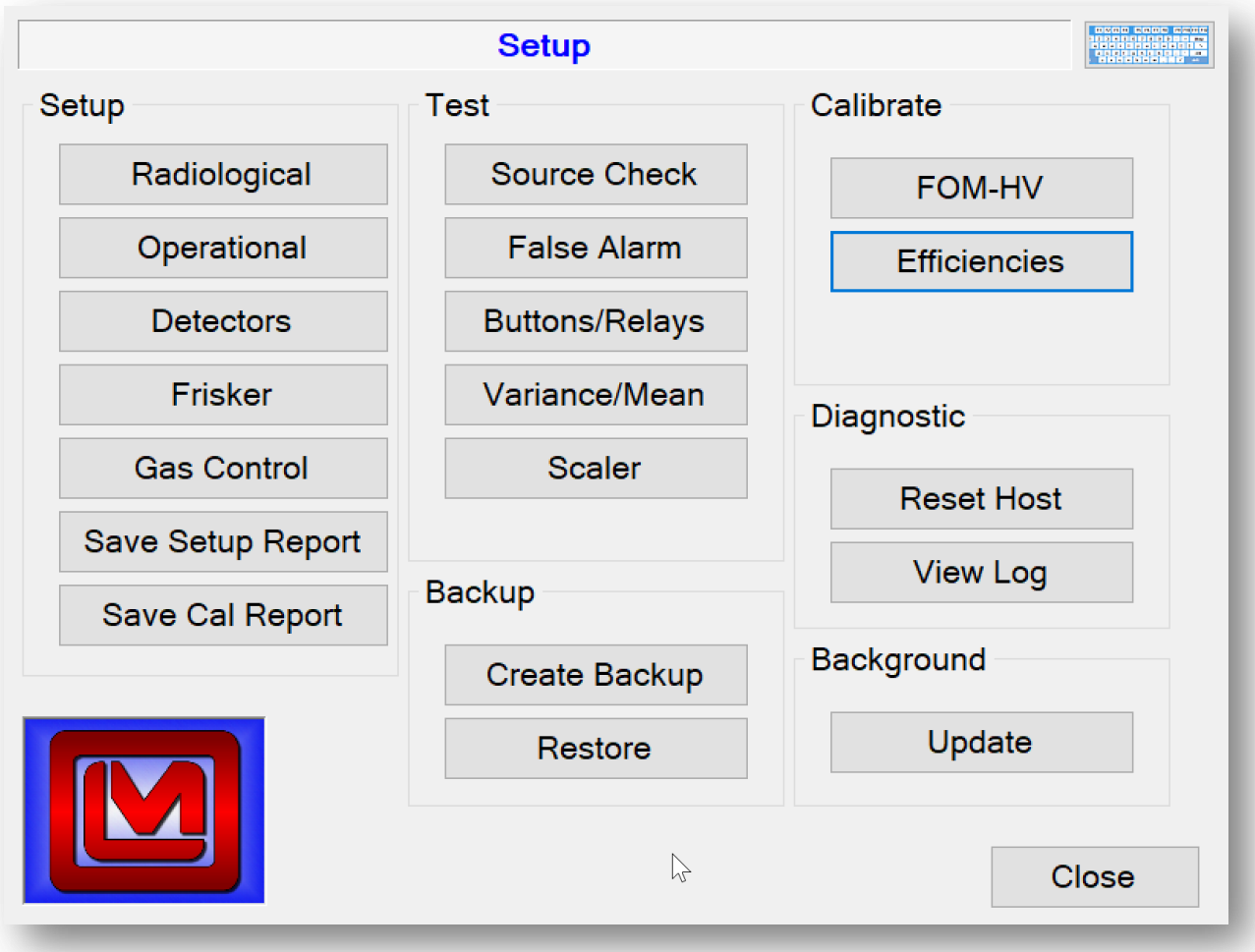


Section

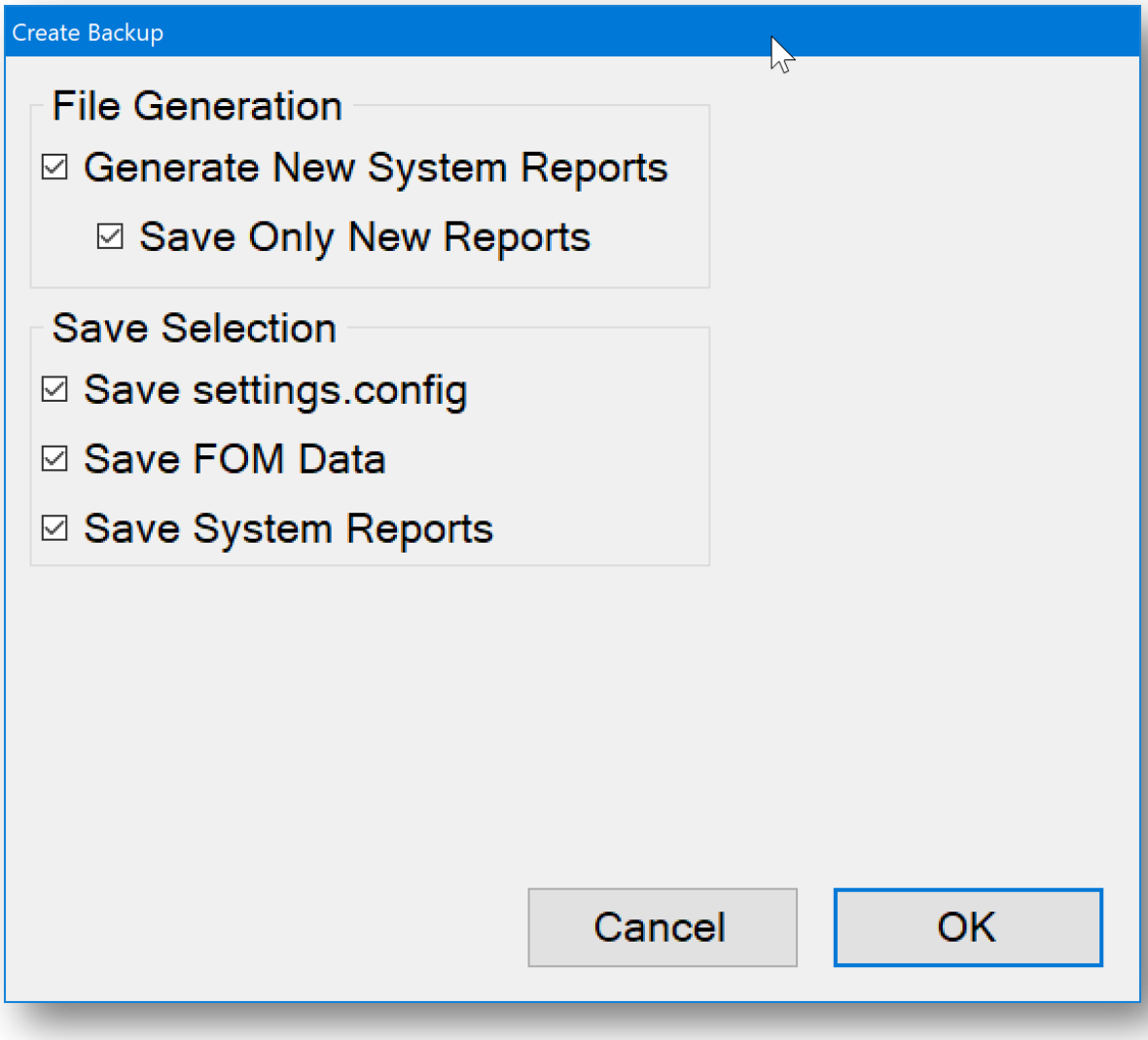
24

Backup and Restore

Backup and Restore utilities are available for Model 4906 Supervisor Software Versions 1.2.6 and beyond. These utilities allow quick and easy backup of important system data as well as an option to restore old settings and data where applicable. The backup and restore utilities are located on the Setup menu in the bottom right corner.



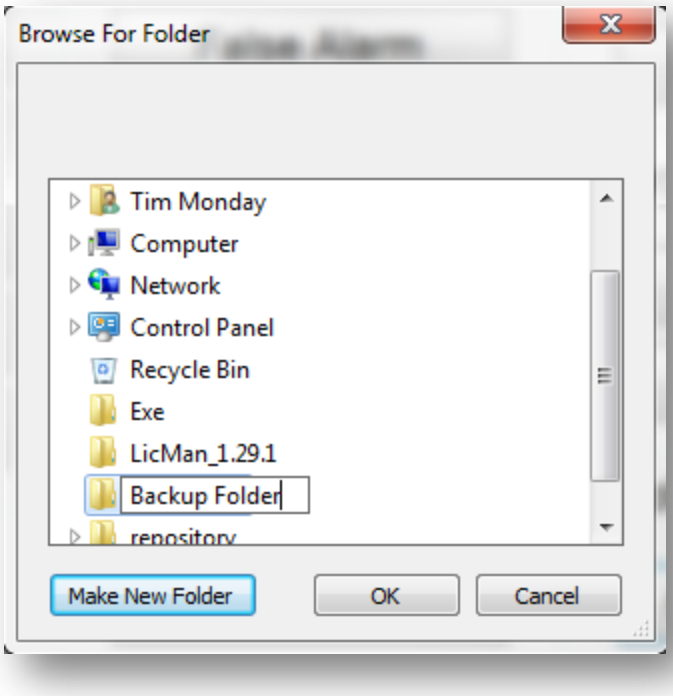
To create a backup, click on the Create Backup button. A window is displayed asking for a few options to be selected regarding how to create the backup and what data to back up.



In the File Generation section, options determining if new report files need to be generated and if only new reports should be saved are available. The Generate New System Reports option will generate a new System, Efficiency, Isotopic Mix, and FOM-HV report to be saved to the back folder when selected. The Save Only New Reports option will save only reports in the Data folder created within the last day. This is a great way to keep old reports from months or years ago out of a current backup.

The Save Selection section determines what files should be saved. When the Save settings.config option is selected, the current settings.config file, which stores the system setup data for use by the Model 4906 Supervisor Software, is backed up. If the Save FOM Data option is selected, all data in the fom folder (where plateau data is stored) from the last FOM-HV plateau is backed up. If the Save System Reports option is selected, then all reports (.rpt) and files in the Data folder are backed up unless the Save Only New Reports option is selected. In that case, only the reports created within the last day are backed up.

Once all options are set as desired, click the OK button to proceed to the backup folder selection window, or Cancel to abort the backup creation process.



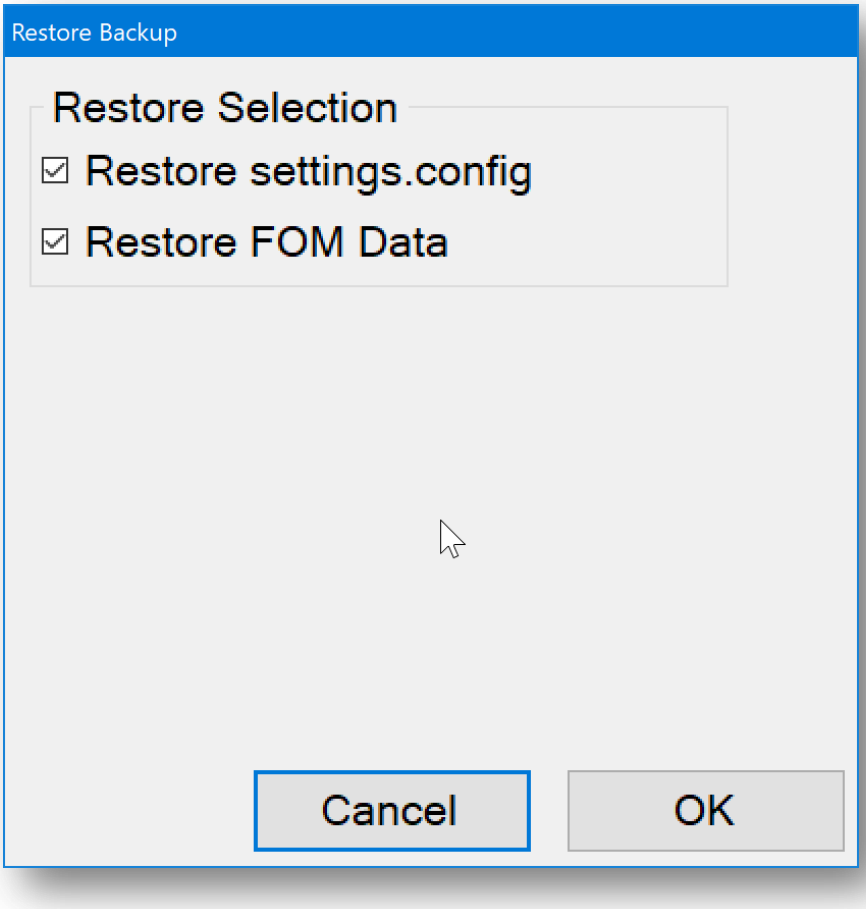
Select or create a top level folder in which the backup data will be placed. Click OK to proceed or Cancel to abort the backup process.

Once OK has been clicked, the backup is created. To confirm the backup was created as you intended, navigate to the designated backup folder location to view the backed up files.

The restore utility allows restoration of data from a previous backup. This restoration is limited to the settings.config file and fom data since these are the only two backup items the Supervisor software reads, not just generates. Additionally, the settings.config file stores information about host, gas control,

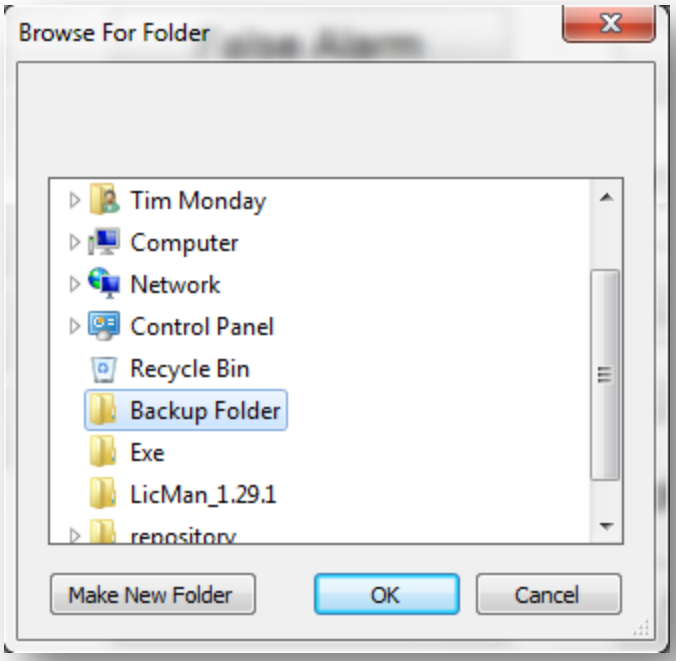
and detector board settings, however these settings and values are actually stored on those individual boards. What this means is that restoring your system options and radiological setup via the settings.config file will not alter your current board specific data such as detector LLD values, firmware version, HV setting, gas error thresholds, and the like. It will restore radiological setup data, system options, system communication options, and other system data. FOM data restoration will make previous FOM data viewable in the FOM screen as if it were the most recently taken FOM data. Current FOM and settings.config data will be overwritten!

Click the Restore button to restore previously backed up data. The restore options window is then displayed.



Selecting the Restore settings.config option will copy the settings.config file from the backup location into the Model 4906 Supervisor home directory, overwriting what was the current settings.config file and reading the new settings into the software. Selecting the Restore FOM Data option will copy FOM data

from the fom folder in the designated backup into the Model 4906 Supervisor home directory fom folder, overwriting what was the current FOM data. Once the restore options are set as desired, click OK to proceed with the restore process, or Cancel to abort the restore process. Once OK is clicked, the restore folder selection window is displayed.



Select the top level backup folder from which to restore, this should be the same folder to either created or selected when a backup was created. The restore utility will locate the specific files to restore based on this folder location. Click OK to proceed or Cancel to abort the restoration process. Once OK is clicked, the restoration will be performed.

To verify the restoration was completed, check an option or setup value that is different in the restoration settings.config file than the previously in use file and verify it has been set to the restoration file value.

Section 25

View Logs

The View Log screen is used to view various log files and reports. Log files and reports are saved in the Data Directory specified in the Logging tab of the Operational screen. The Model 4906 creates several log files automatically. These are:

- System Log
- Background Log
- Scan Log
- Frisker Log

Log files are named with a prefix of the date and time in the format of YYYYMMDD and have a file extension of ".log." These files are ASCII text files and are viewable in any program that can read text files. New log files are created for each day.

The system log file records events relating to the status of the Model 4906 such as:

- Starting and stopping the Supervisor application
- Commands sent to the host board
- Current status
- Pushbutton events
- Alarms and failures

The background log file records the current background and detector status at an interval specified in the logging tab of the Operational screen.

The scan log file records information about the results of the monitoring of an occupant including:

- Date/Time
- Employee ID, if required
- Status and which detector alarmed, if any
- Count time
- Detector readings

Most setup screens have an option to save a report. These reports can be viewed here as well.

Section 26

Changes

Firmware Compatibility
Version 1.5.6 or higher – 420275R05N04
Version 1.5.2 – 420275R05N04
Version 1.5.1 – 420275R05N04
Version 1.5.0 – 420275R05N04
Version 1.4.6 – 420275R05N04
Version 1.4.5 – 420275R05N04
Version 1.4.4 – 420275R05N04
Version 1.4.3 – 420275R05N04
Version 1.4.2 – 420275R05N04
Version 1.4.1 – 420275R05N04
Version 1.4.0 – 420275R05N04
Version 1.2.3 – 1.2.6 – 420275R05N01
Version 1.2.1 – 1.2.2 – 420275R04N01
Version 1.2.0 -- 420275R01N01
Version 1.1.0 – 42007n02

Version 1.6.5
Added current date on main screen.
Tweaked adding isotopes and sources.

Version 1.6.4
Added option to zero the source size every time the source check window is opened, requiring the user to always select the correct source.
Fixed wording on 4906P Source Check showing as an alpha source check.

Version 1.6.3
Changed so both alpha and beta source sizes are saved when using the source check test screen.
Changed so reports are automatically saved after operation rather than requiring user to manually save them.

Version 1.6.2
Fixed issue if the 4096A was selected, the calibration report would not print out the FOM data

Changed so FOM data is loaded when opening setup screen.

Version 1.6.1
Fixed issue where cancelling FOM didn't always work.

Version 1.6.0
Changed background sigma coefficient and false alarm probability default parameters.
Added statement about how newer frisker board may need volume changed using internal pot.

Version 1.5.9
Fixed issue with FOM not showing source counts and enabling buttons at the end of the FOM.
Fixed where light stack didn't turn on the yellow light for failures.

Version 1.5.8
Fixed issue where gas could be enabled for 4906A.

Version 1.5.7
Fixed issues with frisker not showing correct alarm.
Fixed issue with universal software.

Version 1.5.6
Added "Both" option to FOM screen to show crosstalk information.
Changed FOM calculation to be more accurate.
Added feature to only perform HV calibration on selected detectors rather than all of them.
Fixed issues where source check test wouldn't pass every time.
Fixed issue were background sigma coefficient wasn't calculated correctly.

Version 1.5.2
Fixed issue where background was updating when frisker was taken off hook before frisker count started.

Version 1.5.1
Fixed where serial numbers were not saved for the P variant.

Version 1.5.0
Added non latching failures.
Added serial number to filename of calibration and setup reports.
Fixed issue with background fail after a tentative update.

Version 1.4.6

Fixed issue where a low background fail could happen immediately after a tentative background update.

Version 1.4.5
Fixed issue where status was duplicated in status text box on main screen.
Added option to show scan counts in activity units rather than total counts per count time.
Fixed where it was not possible to get beta alarm if alpha alarm occurred.
Fixed issues with scan log not displaying correctly.
Fixed issue with setup/cal report not correctly showing count time in mode 3.
Fixed issue where alarm set point not sent correctly to the universal software.
Fixed issues if scan log was locked by another application.

Version 1.4.4
Fixed where source check was not always checked all detectors at the end of the count requiring multiple counts before a detector would pass.
Changed so voltage cal option is normal option.

Version 1.4.3
Added ability to view calibration reports from log screen.
Fixed issue with one hand mode.
Fixed issues viewing logs and reports.

Version 1.4.2
Fixed issue where efficiency was calculated incorrectly if source size was changed.
Fixed issues when entering isotopic mix and direct efficiencies.

Version 1.4.1
Fixed issue with gas purge and background update.

Version 1.4.0
Added support for the 4906P

Version 1.2.6
Ninth release. Added backup functionality along with some other minor feature options.

Version 1.2.5
Eighth release. Improved communications robustness.

Version 1.2.4
Seventh release. Addition of verbose communication logging.

Version 1.2.3

Sixth release. Addition of alpha no count time out option.

Version 1.2.2
Fifth release. Primarily addition of alpha only functions.

Version 1.2.1
Fourth release. Addition of version 2 gas system capabilities.

Version 1.2.0
Third release.

Version 1.1.0
Second release.

Version 1.0.0
Initial release.

Section

27

Recycling

Ludlum Measurements, Inc. supports the recycling of the electronic products it produces for the purpose of protecting the environment and to comply with all regional, national, and international agencies that promote economically and environmentally sustainable recycling systems. To this end, Ludlum Measurements, Inc. strives to supply the consumer of its goods with information regarding reuse and recycling of the many different types of materials used in its products. With many different agencies – public and private – involved in this pursuit, it becomes evident that a myriad of methods can be used in the process of recycling. Therefore, Ludlum Measurements, Inc. does not suggest one particular method over another, but simply desires to inform its consumers of the range of recyclable materials present in its products, so that the user will have flexibility in following all local and federal laws.

The following types of recyclable materials are present in Ludlum Measurements, Inc. electronic products, and should be recycled separately. The list is not all-inclusive, nor does it suggest that all materials are present in each piece of equipment:

- Batteries
- Glass
- Aluminum and Stainless Steel
- Circuit Boards
- Plastics
- Liquid Crystal Display (LCD)

Ludlum Measurements, Inc. products, which have been placed on the market after August 13, 2005, have been labeled with a symbol recognized internationally as the "crossed-out wheelie bin." This notifies the consumer that the product is not to be mixed with unsorted municipal waste when discarding; each material must be separated. The symbol will be placed near the AC

receptacle, except for portable equipment where it will be placed on the battery lid.

Section 28

Spare Parts List

Model 4906A Spare Parts List

Qty.	Description	Part Number
1 EA.	SWTCH-MPI002/28/BL BLUE	08-6853
1 EA.	SWTCH-MPI002/28/RD RED	08-6854
1 EA.	SPRING-E0180-020-2500-S	21-8920
1 EA.	SPRING-E0180-022-1500-S	21-8921
1 EA.	MONITOR-1291L 12-inch LCD OpenFrame Intellitouch	2311588
1 EA.	CABLE-24184 Ultra Slim Certified Premium High-Speed HDMI	2313120
1 EA.	MODEL 43-148 HADN DET ASSY	4316-225
1 EA.	MODEL 43-148 WINDOW FRAME W/MYLAR	4316-202-1
1 EA.	MODEL 43-40-10 FOOT DET ASSY	4316-132
1 EA.	MODEL 43-40-10 WINDOW FRAME 2/MYLAR	4316-134
1 EA.	MODEL 4906 COMPUTER ASSEMBLY	4420-697
1 EA.	BD(C) MODEL 4906A HOST BOARD	5420-275
1 EA.	BD(C) MODEL 4906A AIR ALPHA DET BOARD	5420-691
1 EA.	BD(C) MODEL 4906A/AB SENSOR COMBINER	5420-540
2 EA.	CBL-MODEL 4906A IR EMITTER W/CONN	8303-770
2 EA.	CBL-MODEL 4906A IR RCEIVER W/CONN	8303-771

Model 4906AB Spare Parts List

Qty.	Description	Part Number
1 EA.	SWTCH-MPI002/28/BL BLUE	08-6853
1 EA.	SWTCH-MPI002/28/RD RED	08-6854
2 EA.	SPRING-E0180-020-2500-S	21-8920
2 EA.	SPRING-E0180-022-1500-S	21-8921
1 EA.	RESTRICTOR-F2815-050B-85	21-9606
1 EA.	VALVE-F-2822-41-B85	21-9643
1 EA.	REGULATOR-2 STG 81L-350	2310017

1 EA.	MONITOR-1291L 12-inch LCD OpenFrame Intellitouch	2311588
1 EA.	CABLE-24184 Ultra Slim Certified Premium High-Speed HDMI	2313120
1 EA.	VALVE-SOLENOID E210A-1C012	2311992
1 EA.	MODEL 43-40-11 HAND DET ASSY	4316-141
1 EA.	MODEL 43-40-12 WINDOW W/MYLAR	4316-162
1 EA.	MODEL 43-40-11 WINDOW FRAME MYLAR	4316-166
1 EA.	MODEL 4906 COMPUTER ASSEMBLY	4420-697
1 EA.	MODEL 43-40-12 FOOT DETECTOR	47-3703
1 EA.	BD(C) MODEL 4906A HOST BOARD	5420-275
1 EA.	MODEL 4906AB GAS FLOW CONTROL BOARD	5420-424
1 EA.	MDOEL 4906AB GAS FLOW SENSOR BOARD	5420-430
1 EA.	BD(C) MODEL 4906AB DETECTOR BOARD (NO AUDIO)	5420-474
1 EA.	BD(C) MODEL 54 POWER RELAY BOARD	5540-170
1 EA.	CBL-MODEL 4906A IR EMITTER W/CONN	8303-770
1 EA.	CBL-MODEL 4906A IR RCVR W/CONN	8303-771
1 EA.	CBL-MHV 6ft RG 62 GAS FLOW CABLE MODEL 43-143	8303-947
1 EA.	HARN-MODEL 4906AB SOLENOID CONN	8420-446

Model 4906P Spare Parts List

Qty.	Description	Part Number
6 EA.	GM TUBE-LND 7311 PANCAKE	01-5008
6 EA.	CLIP-TUBE 122090	01-5237
1 EA.	SWITCH-MPI002/28/BL BLUE	08-6853
1 EA.	SWITCH-MPI002/28/RD RED	08-6854
1 EA.	SPRING-E0180-020-2500-S	21-8920
1 EA.	SPRING-E0180-022-1500-S	21-8921
1 EA.	MONITOR-1291L 12-inch LCD OpenFrame Intellitouch	2311588
1 EA.	CABLE-24184 Ultra Slim Certified Premium High-Speed HDMI	2313120
1EA.	MODEL 4906 COMPUTER ASSEMBLY	4420-697
1 EA.	MODEL 44-208 HAND DET ASSY	4420-552
1 EA.	MODEL 44-209 FOOT DET ASSY	4420-555
1 EA.	BD(C) MODEL 4906A/AB SENSOR COMBINER	5420-540

1EA.	CBL-MODEL 4906A IR EMITTER W/CONN	8303-770
1 EA.	CBL-MODEL 4906A IR RECEIVER W/CONN	8303-771